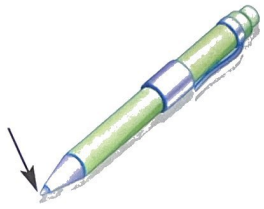
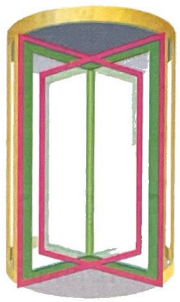
Example 2 **Name the geometric term(s) modeled by each object.**

22. 

23. 

24. 

25. 

26. a blanket

27. a knot in a rope

28. a telephone pole

29. the edge of a desk

30. two connected walls

31. a partially opened folder

Example 3 **Draw and label a figure for each relationship.**

32. Line m intersects plane R at a single point.

33. Two planes do not intersect.

34. Points X and Y lie on $\overleftrightarrow{CD}$.

35. Three lines intersect at point J but do not all lie in the same plane.

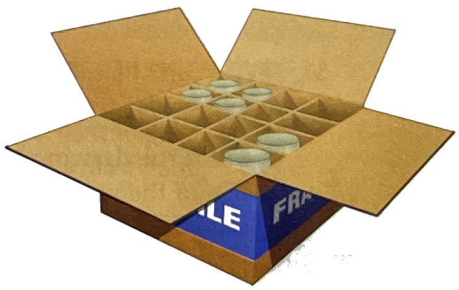
36. Points $A(2, 3)$, $B(2, -3)$, C, and D are collinear, but A, B, C, D, and F are not.

37. Lines $\overleftrightarrow{LM}$ and $\overleftrightarrow{NP}$ are coplanar but do not intersect.

38. $\overleftrightarrow{FG}$ and $\overleftrightarrow{JK}$ intersect at $P(4, 3)$, where point F is at $(-2, 5)$ and point J is at $(7, 9)$.

39. Lines s and t intersect, and line v does not intersect either one.

Example 4 **MODELING When packing breakable objects such as glasses, movers frequently use boxes with inserted dividers like the one shown.**

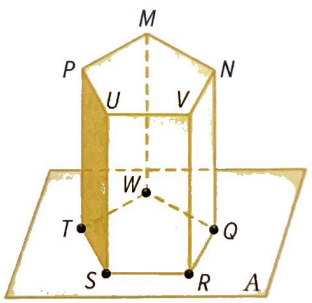


40. How many planes are modeled in the picture?

41. What parts of the box model lines?

42. What parts of the box model points?

Refer to the figure at the right.



43. Name two collinear points.

44. How many planes appear in the figure?

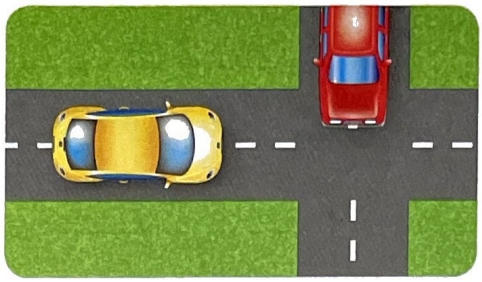
45. Do plane A and plane MNP intersect? Explain.

46. In what line do planes A and QRV intersect?

47. Are points T, S, R, Q, and V coplanar? Explain.

48. Are points T, S, R, Q, and W coplanar? Explain.

53. **TRANSPORTATION** When two cars enter an intersection at the same time on opposing paths, one of the cars must adjust its speed or direction to avoid a collision. Two airplanes, however, can cross paths while traveling in different directions without colliding. Explain how this is possible.



54. **MULTIPLE REPRESENTATIONS** Another way to describe a group of points is called a locus. A **locus** is a set of points that satisfy a particular condition. In this problem, you will explore the locus of points that satisfy an equation.

   a. **Tabular** Represent the locus of points satisfying the equation $2 + x = y$ using a table of at least five values.

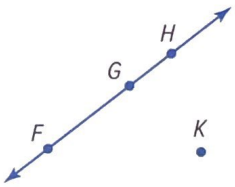
   b. **Graphical** Represent this same locus of points using a graph.

   c. **Verbal** Describe the geometric figure that the points suggest.

55. **PROBABILITY** Three of the labeled points are chosen at random.

   a. What is the probability that the points chosen are collinear?

   b. What is the probability that the points chosen are coplanar?



56. **MULTIPLE REPRESENTATIONS** In this problem, you will explore the locus of points that satisfy an inequality.

   a. **Tabular** Represent the locus of points satisfying the inequality $y < -3x - 1$ using a table of at least 10 values.

   b. **Graphical** Represent this same locus of points using a graph.

   c. **Verbal** Describe the geometric figure that the points suggest.

H.O.T. Problems Use Higher-Order Thinking Skills

57. **OPEN-ENDED** Sketch three planes that intersect in a line.

58. **ERROR ANALYSIS** Camille and Hiroshi are trying to determine the most number of lines that can be drawn using any two of four random points. Is either correct? Explain.

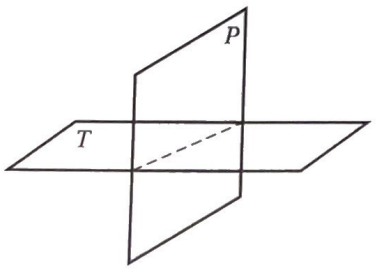
Camille	Hiroshi
Because there are four points, 4 · 3 or 12 lines can be drawn between the points.	You can draw 3 · 2 · 1 or 6 lines between the points.

59. **CONSTRUCT ARGUMENTS** What is the greatest number of planes determined using any three of the points A, B, C, and D if no three points are collinear?

60. **REASONING** Is it possible for two points on the surface of a prism to be neither collinear nor coplanar? Justify your answer.

61. **WRITING IN MATH** Refer to Exercise 49. Give a real-life example of a finite plane. Is it possible to have a real-life object that is an infinite plane? Explain your reasoning.

62. The figure illustrates the intersection of plane P and plane T. The planes extend infinitely in all directions. What undefined term best describes the intersection? MP 6



- ○ **A** line
- ○ **B** plane
- ○ **C** point
- ○ **D** segment

63. Four lines are coplanar. What is the greatest number of intersection points that can exist? MP 4

64. Which of the following terms are undefined? Select all that apply. MP 6

- ○ **A** distance
- ○ **B** line
- ○ **C** point
- ○ **D** plane
- ○ **E** space

65. Dwayne is walking on a straight sidewalk. He spots a vertical flagpole 10 feet to his right. His friend Ursula says that the flagpole and sidewalk can be used to model two lines. Which term best describes the sidewalk and the flagpole? MP 4, 6

- ○ **A** collinear
- ○ **B** skew
- ○ **C** parallel
- ○ **D** intersecting

66. Samir is using a compass to draw a circle on a piece of paper. He places the metal tip of the compass at one location on the paper, and then moves the pencil around the tip to draw the figure. Which of the following models a term that can be defined? MP 4, 6

- ○ **A** the location of the metal tip on the paper
- ○ **B** the plane that contains the piece of paper
- ○ **C** the tip of the pencil
- ○ **D** the circle drawn by the pencil

67. Which undefined term is best modeled by a laptop screen? MP 6

- ○ **A** line
- ○ **B** parallel
- ○ **C** plane
- ○ **D** rectangle

68. **MULTI-STEP** Name the geometric term(s) modeled by each object. MP 4, 6

a. two sides of a roof

b. a driveway

c. two connected desks

d. end of a pencil

e. cell phone screen

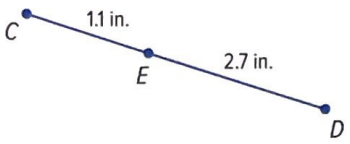
f. fence post

Check Your Understanding

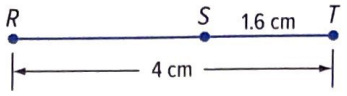
= Step-by-Step Solutions begin on page R13.

Example 1 **Find each measure. Assume that the figures are not drawn to scale.**

1. CD



2. RS

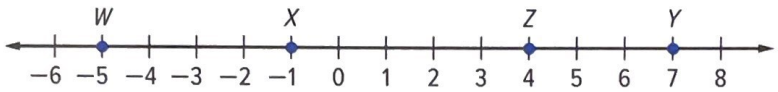


Example 2 **ALGEBRA Find the value of x and BC if B is between C and D.**

3. $CB = 2x$, $BD = 4x$, and $BD = 12$

4. $CB = 4x - 9$, $BD = 3x + 5$, and $CD = 17$

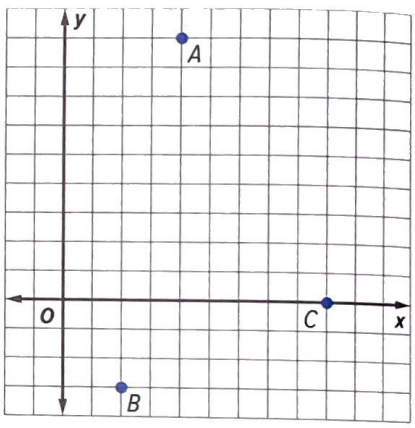
Example 3 **Use the number line to find each measure.**



5. XY

6. WZ

Example 4 **TIME CAPSULE** Graduating classes have buried time capsules on the campus of East Side High School for over 20 years. The points on the diagram show the position of three time capsules. Find the distance between each pair of time capsules.



7. $A(4, 9)$, $B(2, -3)$

8. $A(4, 9)$, $C(9, 0)$

9. $B(2, -3)$, $C(9, 0)$

Example 5

10. MP **STRUCTURE** Which two time capsules are the closest to each other? Which are farthest apart?

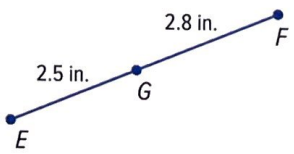
Practice and Problem Solving

Extra Practice is found on page R1.

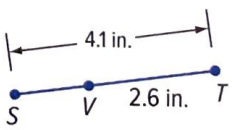
Example 1 **Find each measure. Assume that the figures are not drawn to scale.**

11. JL

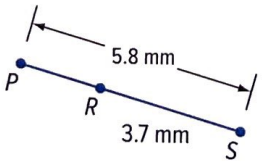
12. EF



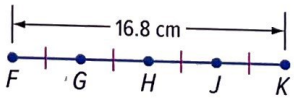
13. SV



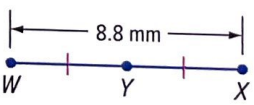
14. PR



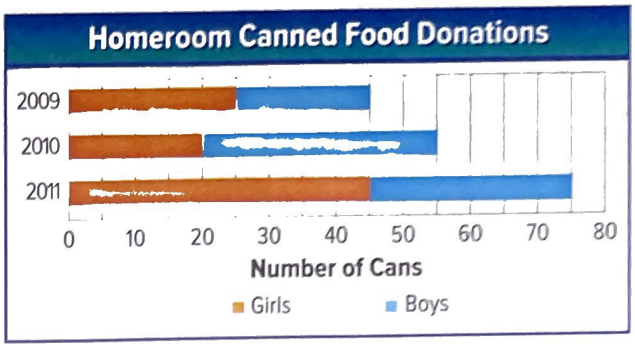
15. FG



16. WY



17. MP **SENSE-MAKING** The stacked bar graph shows the number of canned food items donated by the students in a homeroom class over three years. Use the concept of betweenness of points to find the number of cans donated by the boys for each year. Explain your method.



Example 2 **ALGEBRA** Find the value of the variable and YZ if Y is between X and Z.

18. $XY = 11, YZ = 4c, XZ = 83$

19. $XY = 6b, YZ = 8b, XZ = 175$

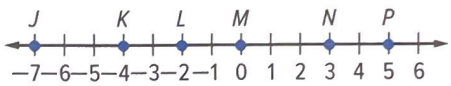
20. $XY = 7a, YZ = 5a, XZ = 6a + 24$

21. $XY = 11d, YZ = 9d - 2, XZ = 5d + 28$

22. $XY = 4n + 3, YZ = 2n - 7, XZ = 22$

23. $XY = 3a - 4, YZ = 6a + 2, XZ = 5a + 22$

Example 3 Use the number line to find each measure.



24. JL

25. JK

26. KP

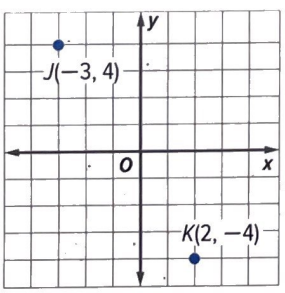
27. NP

28. JP

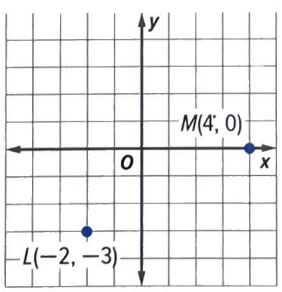
29. LN

Example 4 Find the distance between each pair of points.

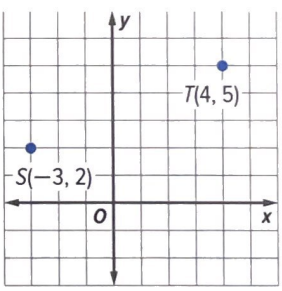
30.



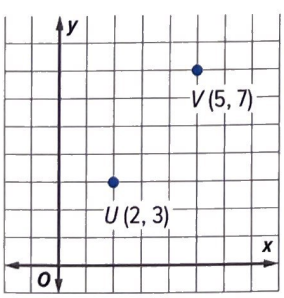
31.



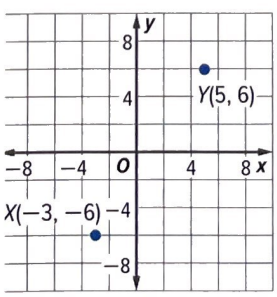
32.



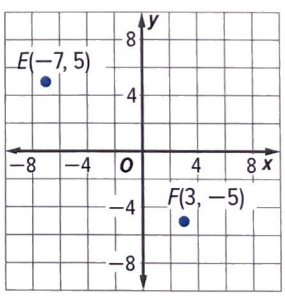
33.



34.



35.



Find the distance between each pair of points.

36. $X(1, 4)$, $Y(6, 9)$

37. $P(3, 4)$, $Q(7, 2)$

38. $M(-3, 8)$, $N(-5, 1)$

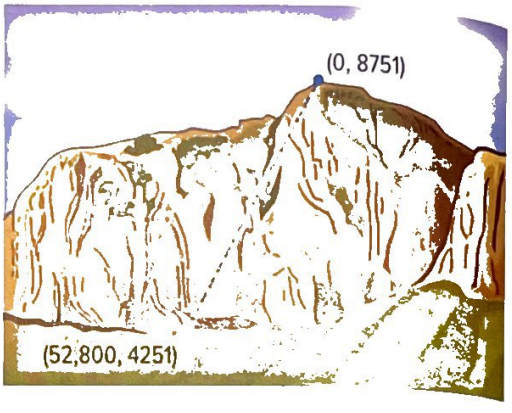
39. $Y(-4, 9)$, $Z(-5, 3)$

40. $A(2, 4)$, $B(5, 7)$

41. $C(5, 1)$, $D(3, 6)$

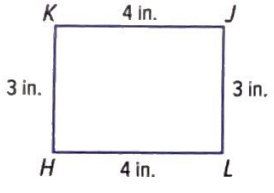
Examples 5

42. MP **REASONING** Vivian is planning to hike to the top of Guadalupe Peak on her family vacation. The coordinates of the peak of the mountain and of the base of the trail are shown in feet. If the trail can be approximated by a straight line, estimate the length of the trail to the nearest tenth of a mile. (*Hint:* 1 mi = 5280 ft)

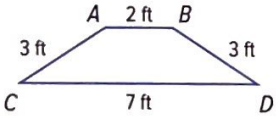


Determine whether each pair of segments is congruent.

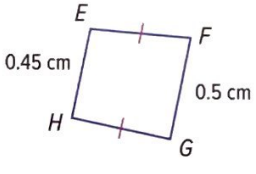
43 $\overline{KJ}$, $\overline{HL}$



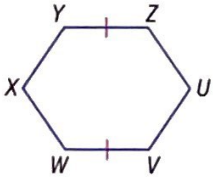
44. $\overline{AC}$, $\overline{BD}$



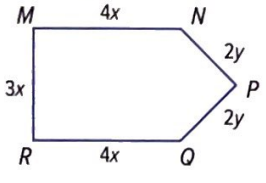
45. $\overline{EH}$, $\overline{FG}$



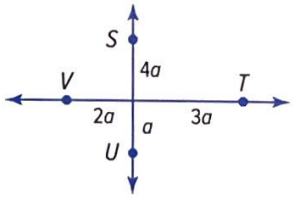
46. $\overline{VW}$, $\overline{UZ}$



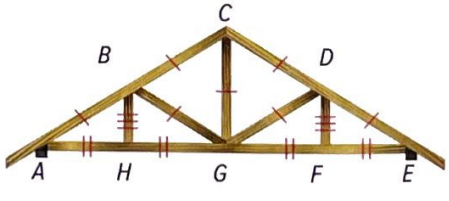
47. $\overline{MN}$, $\overline{RQ}$



48. $\overline{SU}$, $\overline{VT}$



49. **TRUSSES** A truss is a structure used to support a load over a span, such as a bridge or the roof of a house. List all of the congruent segments in the figure.



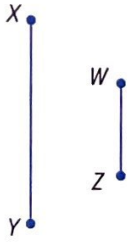
50. **CONSTRUCTION** For each expression:

- construct a segment with the given measure,
- explain the process you used to construct the segment, and
- verify that the segment you constructed has the given measure.

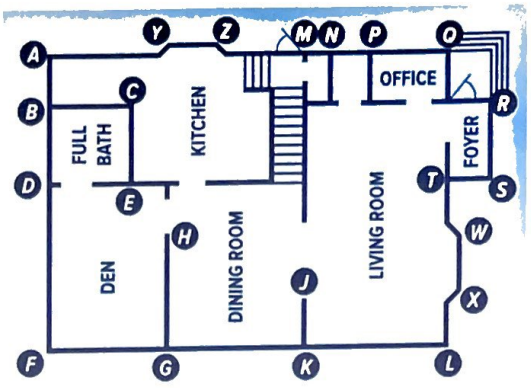
a. WZ

b. $2(XY)$

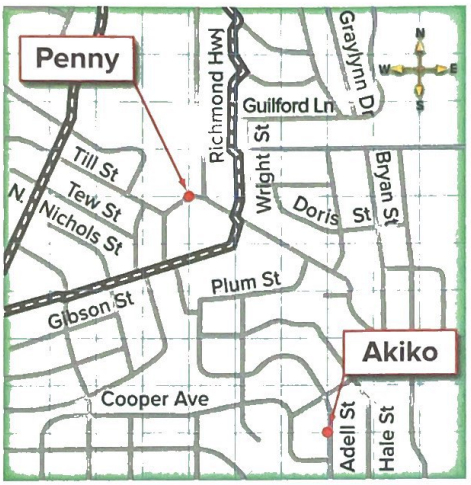
c. $6(WZ) - XY$



51 **BLUEPRINTS** Use a ruler to determine at least five pairs of congruent segments with labeled endpoints in the blueprint shown.



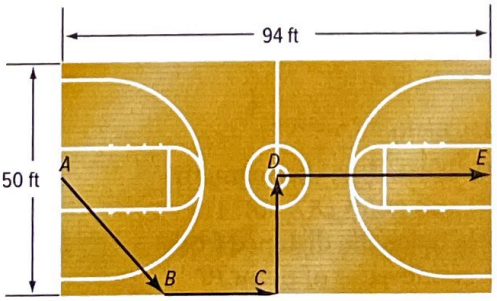
52. MP **MODELING** Penny and Akiko live in the locations shown on the map below.



a. If each square on the grid represents one block and the bottom left corner of the grid is the location of the origin, what is the distance from Penny's house to Akiko's?

b. If Penny moves 3 blocks to the north and Akiko moves 5 blocks to the west, how far apart will they be?

53. **MULTI-STEP** Coach Willis designs a play that requires the ball to be passed from point *A* to point *E* as shown below. The arrows represent quick passes to different members of his team. Randi can throw the ball from under the basket to midcourt, Jen and Mandy can throw the ball half the width of the court, Makayla can throw the ball to the free throw line from under the basket, and Kim can throw the ball farther than Jen.



a. In which position should each girl be?

b. Describe your solution process.

c. What assumptions did you make?

54. MULTIPLE REPRESENTATIONS Betweenness of points ensures that a line segment may be divided into an infinite number of line segments.

a. Geometric Use a ruler to draw a line segment 3 centimeters long. Label the endpoints A and D. Draw two more points along the segment and label them B and C. Draw a second line segment 6 centimeters long. Label the endpoints K and P. Add four more points along the line and label them L, M, N, and O.

b. Tabular Use a ruler to measure the length of the line segment between each of the points you have drawn. Organize the lengths of the segments in $\overline{AD}$ and $\overline{KP}$ into a table. Include a column in your table to record the sum of these measures.

$\overline{AD}$		$\overline{KP}$	
Segment	Length (cm)	Segment	Length (cm)
$\overline{AB}$		$\overline{KL}$	
$\overline{BC}$		$\overline{LM}$	
$\overline{CD}$		$\overline{MN}$	
Total		$\overline{NO}$	
		$\overline{OP}$	
		Total	

c. Algebraic Write an equation that could be used to find the lengths of $\overline{AD}$ and $\overline{KP}$. Compare the lengths determined by your equation to the actual lengths.

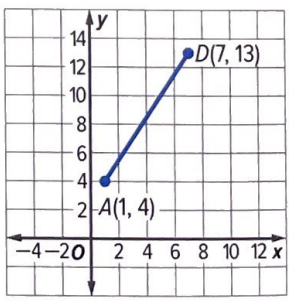
H.O.T. Problems Use Higher-Order Thinking Skills

55. WRITING IN MATH If point B is between points A and C, explain how you can find AC if you know AB and BC. Explain how you can find BC if you know AB and AC.

56. TOOLS Draw a segment $\overline{AB}$ that measures between 2 and 3 inches long. Then sketch a segment $\overline{CD}$ congruent to $\overline{AB}$, draw a segment $\overline{EF}$ congruent to $\overline{AB}$, and construct a segment $\overline{GH}$ congruent to $\overline{AB}$. Compare your methods.

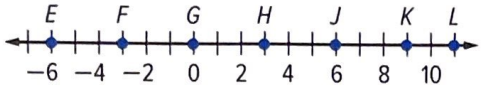
57. REASONING Determine whether the statement *If point M is between points C and D, then CD is greater than either CM or MD* is *sometimes*, *never*, or *always* true. Explain.

58. CHALLENGE Point P is located on the segment between point $A(1, 4)$ and point $D(7, 13)$. The distance from A to P is twice the distance from P to D. What are the coordinates of point P?



59. WRITING IN MATH Explain how the Pythagorean Theorem is used to derive the Distance Formula.

Example 2 **Use the number line to find the coordinate of the midpoint of each segment.**



14. $\overline{JL}$ **15.** $\overline{HK}$ **16.** $\overline{FG}$

17. $\overline{EF}$ **18.** $\overline{EL}$ **19.** $\overline{FK}$

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

20. $W(12, 2)$, $X(7, 9)$

21 $C(22, 4)$, $B(15, 7)$

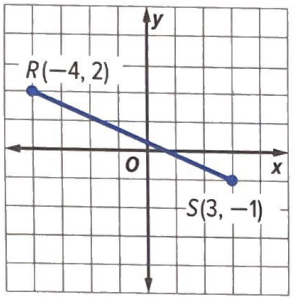
22. $V(-2, 5)$, $Z(3, -17)$

23. $D(-15, 4)$, $E(2, -10)$

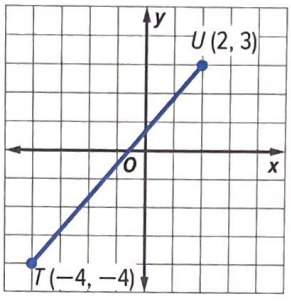
24. $J(-11.2, -3.4)$, $K(-5.6, -7.8)$

25. $X(-2.4, -14)$, $Y(-6, -6.8)$

26.



27.



Example 3 **Find the coordinates of the missing endpoint if B is the midpoint of $\overline{AC}$.**

28. $A(1, 7)$, $B(-3, 1)$ **29.** $C(-5, 4)$, $B(-2, 5)$ **30.** $C(-6, -2)$, $B(-3, -5)$

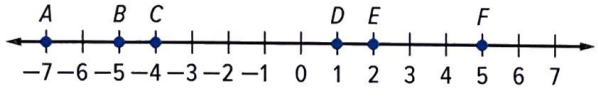
31. $A(-4, 2)$, $B(6, -1)$ **32.** $C\left(\frac{5}{3}, -6\right)$, $B\left(\frac{8}{3}, 4\right)$ **33.** $A(4, -0.25)$, $B(-4, 6.5)$

Example 4 **Suppose M is the midpoint of $\overline{FG}$. Find each missing measure.**

34. $FM = 5y + 13$, $MG = 5 - 3y$, $FG = ?$ **35.** $FM = 3x - 4$, $MG = 5x - 26$, $FG = ?$

36. $FM = 8a + 1$, $FG = 42$, $a = ?$ **37.** $MG = 7x - 15$, $FG = 33$, $x = ?$

Example 5 **MP PERSEVERENCE** Refer to the number line.



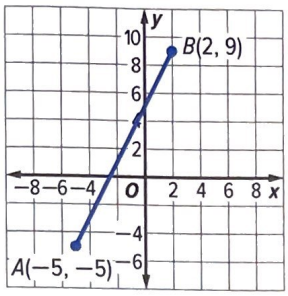
38. Find the point X on $\overline{CF}$ that is $\frac{1}{5}$ of the distance from C to F.

39. Find the point X on $\overline{BD}$ that is $\frac{2}{3}$ of the distance from B to D.

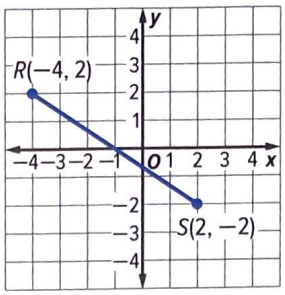
40. Find the point X on $\overline{AE}$ that is $\frac{1}{6}$ of the distance from A to E.

41. Find the point X on $\overline{AF}$ that is $\frac{4}{5}$ of the distance from A to F.

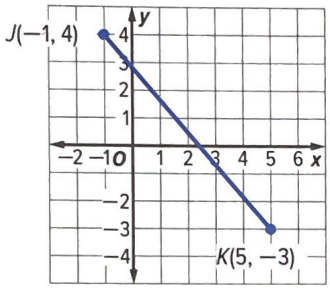
Examples 6–7 **42.** Find X on $\overline{AB}$ that is $\frac{1}{5}$ the distance from A to B.



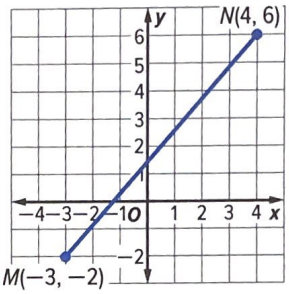
43. Find X on $\overline{RS}$ that is $\frac{1}{6}$ the distance from R to S.



44. Find X on $\overline{JK}$ such that the ratio of JX to XK is 1:2.



45. Find X on $\overline{MN}$ such that the ratio of MX to XN is 2:1.

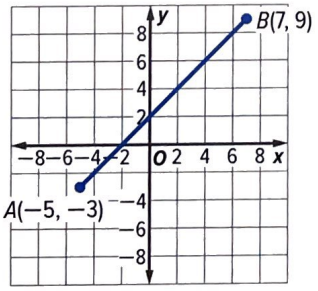


Determine the coordinates of the points that satisfy each condition.

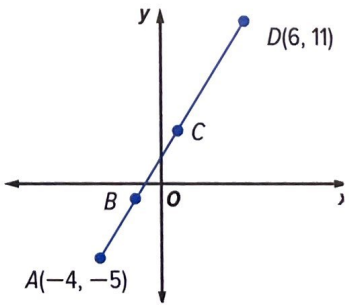
46. Two points on the y-axis are 25 units from $(-24, 3)$.

47 Two points on the x-axis are 10 units from $(1, 8)$.

48. MP **MODELING** Points A and B represent two cities. Where should the state place a rest area so it is halfway between cities A and B?



49. **COORDINATE GEOMETRY** Find the coordinates of B if B is halfway between $\overline{AC}$ and C is halfway between $\overline{AD}$.



50. **GEOMETRY** One endpoint of $\overline{AB}$ has coordinates $(-3, 5)$. If the coordinates of the midpoint of $\overline{AB}$ are $(2, -6)$, what is the length of $\overline{AB}$?

51. **CONSTRUCTION** Copy the figure. Use a compass and straightedge to determine whether B is the midpoint of $\overline{AD}$. Explain.