1-2 Line Segments and Distance

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

1. \( \overline{CD} \)
   \[
   C \quad \begin{array}{c}
   1.1 \text{ in.} \\
   E \quad 2.7 \text{ in.}
   \end{array} D
   \]
   \textit{ANSWER:} 3.8 in.

2. \( \overline{RS} \)
   \[
   R \quad \begin{array}{c}
   4 \text{ cm} \\
   S \quad 1.6 \text{ cm}
   \end{array} T
   \]
   \textit{ANSWER:} 2.4 cm

\textbf{ALGEBRA} Find the value of } \( x \) \text{ and } \( BC \) \text{ if } \( B \) \text{ is between } \( C \) \text{ and } \( D \).

3. \( CB = 2x \), \( BD = 4x \), and \( BD = 12 \)
   \textit{ANSWER:} \( x = 3 \); \( BC = 6 \)

4. \( CB = 4x - 9 \), \( BD = 3x + 5 \), and \( CD = 17 \)
   \textit{ANSWER:} \( x = 3 \); \( BC = 3 \)

Use the number line to find each measure.

5. \( \overline{XY} \)
   \textit{ANSWER:} 8

6. \( \overline{WZ} \)
   \textit{ANSWER:} 9

\textbf{TIME CAPSULE} Graduating classes have buried time capsules on the campus of East Side High School for over twenty years. The points on the diagram show the position of three time capsules. Find the distance between each pair of time capsules.

7. \( A(4, 9), B(2, -3) \)
   \textit{ANSWER:} \( \sqrt{148} \) or about 12.2 units

8. \( A(4, 9), C(9, 0) \)
   \textit{ANSWER:} \( \sqrt{106} \) or about 10.3 units

9. \( B(2, -3), C(9, 0) \)
   \textit{ANSWER:} \( \sqrt{58} \) or about 7.6 units

10. \textbf{ANALYZE RELATIONSHIPS} Which two time capsules are the closest to each other? Which are farthest apart?
   \textit{ANSWER:} \( B \) and \( C \); \( A \) and \( B \)

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

11. \( \overline{IL} \)
   \[
   J \quad \begin{array}{c}
   0.75 \text{ cm} \\
   K \quad 0.35 \text{ cm}
   \end{array} L
   \]
   \textit{ANSWER:} 1.1 cm
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12. $\overline{EF}$

**ANSWER:**
5.3 in.

13. $\overline{SV}$

**ANSWER:**
1.5 in.

14. $\overline{PR}$

**ANSWER:**
2.1 mm

15. $\overline{FG}$

**ANSWER:**
4.2 cm

16. $\overline{WX}$

**ANSWER:**
4.4 mm

17. **ORGANIZE IDEAS** The stacked bar graph shows the number of canned food items donated by the girls and the boys 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.

**ANSWER:**
2009: 20 cans, 2010: 35 cans, 2011: 30 cans; Subtract the number of cans the girls brought in from the total number of cans brought in by the girls and the boys.

Find the value of the variable and $YZ$ if $Y$ is between $X$ and $Z$.

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

**ANSWER:**
$c = 18$; $YZ = 72$

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

**ANSWER:**
$b = 12.5$; $YZ = 100$

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

**ANSWER:**
$a = 4$; $YZ = 20$

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

**ANSWER:**
$d = 2$; $YZ = 16$

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

**ANSWER:**
$n = 4\frac{1}{3}$; $YZ = 1\frac{2}{3}$
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23. \(XY = 3a - 4, YZ = 6a + 2, XZ = 5a + 22\)

   \textit{ANSWER:}
   
   \(a = 6; YZ = 38\)

   Use the number line to find each measure.

   \[\begin{array}{cccccccc}
   J & K & L & M & N & O & P \\
   -7 & -6 & -5 & -4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6
   \end{array}\]

24. \(JL\)

   \textit{ANSWER:}
   
   5

25. \(JK\)

   \textit{ANSWER:}
   
   3

26. \(KP\)

   \textit{ANSWER:}
   
   9

27. \(NP\)

   \textit{ANSWER:}
   
   2

28. \(JP\)

   \textit{ANSWER:}
   
   12

29. \(LN\)

   \textit{ANSWER:}
   
   5

   Find the distance between each pair of points.

   \texttt{Sample answer: I measured the distance between }J\texttt{ and }K\texttt{ to be 5 units.}

   \[\begin{array}{ccc}
   J(-3, 4) & O & K(2, -4)
   \end{array}\]

30. \(\textit{ANSWER:}\)

   \[\sqrt{89}\] or about 9.4 units

\[\begin{array}{ccc}
\text{O} & \text{M(4, 0)} & \text{L(-2, -3)}
\end{array}\]

31. \(\textit{ANSWER:}\)

   \[\sqrt{45}\] or about 6.7 units

\[\begin{array}{ccc}
\text{O} & \text{T(4, 5)} & \text{S(-3, 2)}
\end{array}\]

32. \(\textit{ANSWER:}\)

   \[\sqrt{58}\] or about 7.6 units

\[\begin{array}{ccc}
\text{O} & \text{V(5, 7)} & \text{U(2, 3)}
\end{array}\]

33. \(\textit{ANSWER:}\)

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

1. **ANSWER:** 3.8 in.

2. **ANSWER:** Not provided.

3. **ANSWER:** (5, 10)

4. **ANSWER:** To record the sum of these measures.

5. **ANSWER:** To record the sum of these measures.

6. **ANSWER:** Always be greater than either of its parts.

7. **ANSWER:** Congruent.

8. **ANSWER:** Yes.

9. **ANSWER:** Yes.

10. **ANSWER:** Yes.

11. **ANSWER:** Determining wh...nt of the trail to the nearest tenth of a mile. (Hint: 1 mi = 5280 ft)

12. **ANSWER:** 10.0 mi

13. **Determine whether each pair of segments is congruent.**

14. **ANSWER:** Yes

15. **ANSWER:** Yes

16. **ANSWER:** 10.0 mi
45. $\overline{EH}, \overline{FG}$

![Image of a rectangle with sides labeled EH and FG]

**ANSWER:** no

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

![Image of a hexagon with vertices labeled V, W, U, and Z]

**ANSWER:** Cannot be determined from the information given.

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

![Image of a rectangle with sides labeled MN and RQ]

**ANSWER:** yes

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

![Image of a cross with segments SU and VT]

**ANSWER:** yes

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.

![Image of a truss structure]

**ANSWER:**

$\overline{AB} \cong \overline{BC} \cong \overline{CD} \cong \overline{DE} \cong \overline{DG} \cong \overline{BG} \cong \overline{CG}$,
$\overline{AH} \cong \overline{HG} \cong \overline{GF} \cong \overline{FE}$, $\overline{BH} \cong \overline{DF}$,
$\overline{AC} \cong \overline{EC}$, $\overline{AG} \cong \overline{HF} \cong \overline{GE}$

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. $\overline{WZ}$

b. $2(\overline{XY})$

c. $6(\overline{WZ}) - \overline{XY}$

**ANSWER:**

a. Sample answer: I measured $\overline{WZ}$ with my compass by placing the point of my compass at $W$ and adjusting the compass until the pencil point was at $Z$. Then with the compass point at $A$, I drew an arc that intersected the ray. The intersection point is $B$. $\overline{AB}$ is the same length as $\overline{WZ}$. 

b.
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Sample answer: I measured \( \overline{XY} \) with my compass and used this measurement to construct \( \overline{XY} \) two times. Since I used the same arc measure to construct \( \overline{XY} \) two times, the segment is 2\((XY)\).

c.

Sample answer: I measured \( \overline{WZ} \) with my compass and constructed 6 segments equal to \( \overline{WZ} \). I measured \( \overline{XY} \) and subtracted this measurement from the segment just constructed. Since I used the same arc measure to construct six \( \overline{WZ} \) segments, the segment is 6\((WZ)\). I then used the arc measure of \( \overline{XY} \) to subtract from my previous segment. So, the resulting segment is 6\((WZ) - XY\).

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

\[ \overline{BD} \cong \overline{CE}, \quad \overline{BD} \cong \overline{PQ}, \quad \overline{YZ} \cong \overline{JK}, \quad \overline{PQ} \cong \overline{RS}, \quad \overline{GK} \cong \overline{KL}. \]

52. APPLY MATH 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 straight-line distance from Penny’s house to Akiko’s?

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

\[ \text{ANSWER:} \]

a. 5.8 blocks

b. 8.2 blocks
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?

ANSWER:
a. A: Kim, B: Jen or Mandy, C: Jen or Mandy, D: Randi, E: Makayla
b. I know that Makayla can throw the shortest distance of all 5 team members and that Randi can throw the farthest. So I chose to place these players at points E and D, respectively. Jen and Mandy can each throw 25 feet (half the width of the court), so I placed them at either point B or point C. Kim will be at point A, and the team will be able to complete the play provided Kim can throw at least 33.3 feet.
c. I assumed that the player at point B would be 25 feet from point C.

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 \( AD \) and \( KP \) into a table. Include a column in your table to record the sum of these measures.

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

ANSWER:

a. Sample answer: 

```
A B C D
```

b. Sample answers given.

```
Segment | Length (cm) | Segment | Length (cm)
--------|-------------|---------|-------------
AD      | 3           | 2        | 1           |
BC      | 3           | 2        | 1           |
CD      | 1           | 1        | 1           |
Total   | 5           | 4        | 3           |
          |             |          | 10          |
```

c. \( AD = AB + BC + CD \); \( KP = KL + LM + MN + NO + OP \); the lengths of each segment add up to the length of the whole segment.

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.

ANSWER:

If point B is between points A and C, and you know AB and BC, add AB and BC to find AC. If you know AB and AC, subtract AB from AC to find BC.
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56. **TOOLS AND TECHNIQUES** Draw a segment \( AB \) that measures between 2 and 3 inches long.
Then sketch a segment \( CD \) congruent to \( AB \), draw a segment \( EF \) congruent to \( AB \), and construct a segment \( GH \) congruent to \( AB \). Compare your methods.

**ANSWER:**

Both \( AB \) and \( EF \) were created using a ruler, while \( GH \) was created using a straightedge and compass and \( CD \) was created without any of these tools.
\( AB \), \( EF \), and \( GH \) have the same measure, but \( CD \) not only does not have the same length, it isn’t even a straight line.

57. **JUSTIFY ARGUEMENTS** 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.

**ANSWER:**
Always; if point \( M \) is between points \( C \) and \( D \), then \( CM + MD = CD \). Since measures cannot be negative, \( CD \), which represents the whole, must always be greater than either of the lengths of its parts, \( CM \) or \( MD \).

58. **ANALYZE RELATIONSHIPS** 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 \( P \)?

**ANSWER:**

\( (5, 10) \)