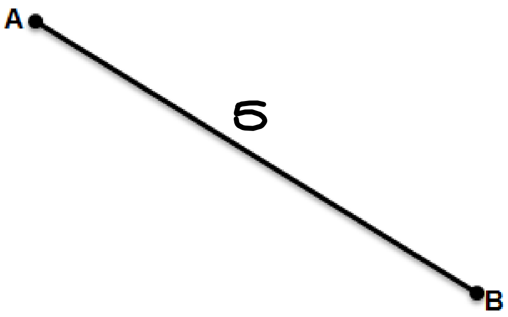
1-2 LINEAR MEASURE

Unlike a line, a **line segment** (or just **segment**) can be measured because it has two endpoints.



Segment AB has endpoints A and B.

Its name can be written as $\overline{AB}$ or $\overline{BA}$.

The *measure* of $\overline{AB}$ is written as AB.

For example, we could say AB = 5, but

not $\overline{AB} = 5$.

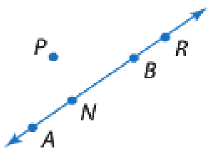
Betweenness of Points

Recall that between any two real numbers *a* and *b*, there is a real number *n* such that $a < n < b$.

This relationship also applies to points on a line and is called **betweenness of points**.

For example, in this picture, point N is between points A and B, but points R and P are not.

Point P is NOT collinear with A and B.



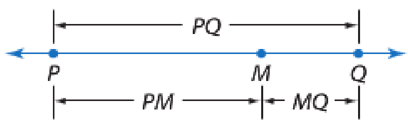
The following concept of "betweenness of points" is often referred to in Geometry as the **segment addition postulate**:

KeyConcept Betweenness of Points

Words

Point M is between points P and Q if and only if P, Q, and M are collinear and $PM + MQ = PQ$.

Model



The length of $\overline{PM}$ plus the length of $\overline{MQ}$ equals the length of $\overline{PQ}$.

Segments that have the same measure are called **congruent segments**.

WatchOut!

Equal vs. Congruent Lengths are equal and segments are congruent. It is correct to say that $AB = CD$ and $\overline{AB} \cong \overline{CD}$. However, it is *not* correct to say that $\overline{AB} = \overline{CD}$ or that $AB \cong CD$.

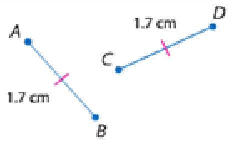
KeyConcept Congruent Segments

Words Congruent segments have the same measure.

Symbols $\cong$ is read *is congruent to*. Red slashes on the figure also indicate congruence.

$\cong$

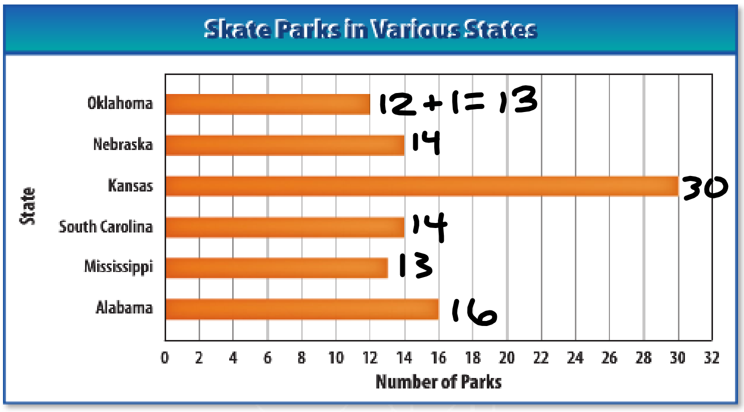
Example $\overline{AB} \cong \overline{CD}$



"Segment AB is congruent to Segment CD."

ex.

SKATE PARKS **In the graph, suppose a segment was drawn along the top of each bar. Which states would have segments that are congruent? Explain.**



Source: SITE Design Group, Inc.

$\overline{NE} \cong \overline{SC}$ because have the same number of skate parks (14).

Now, suppose Oklahoma added another skate park. The segment drawn along the bar representing Oklahoma would be congruent to which other segment? Mississippi ex. Name the congruent segments for the sign shown here:

$\overline{AB} \cong \overline{AG}$

$\overline{BC} \cong \overline{GF}$

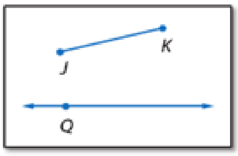
$\overline{CD} \cong \overline{FE}$

Drawings of geometric figures are created using measuring tools such as a ruler and protractor. **Constructions** are methods of creating these figures without the benefit of measuring tools. Generally, only a pencil, straightedge, and compass are used in constructions. *Sketches* are created without the use of any of these tools.

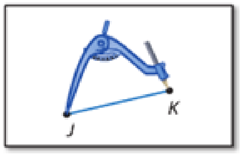
You can construct a segment that is congruent to a given segment.

Construction Copy a Segment

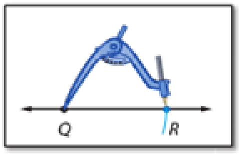
Step 1 Draw a segment $\overline{JK}$. Elsewhere on your paper, draw a line and a point on the line. Label the point Q.



Step 2 Place the compass at point J and adjust the compass setting so that the pencil is at point K.

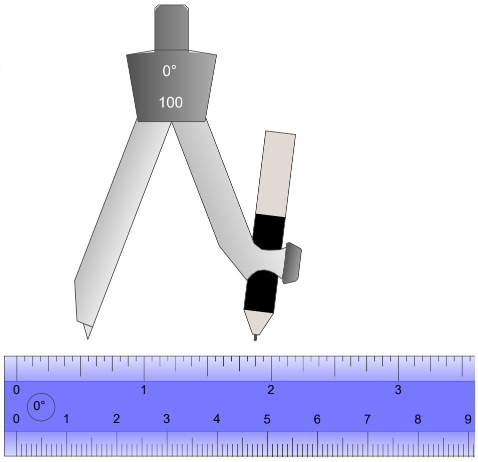


Step 3 Using that setting, place the compass point at Q and draw an arc that intersects the line. Label the point of intersection R. $\overline{JK} \cong \overline{QR}$



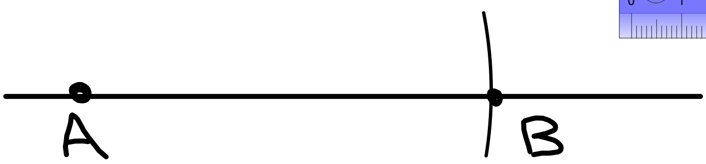
Try some:

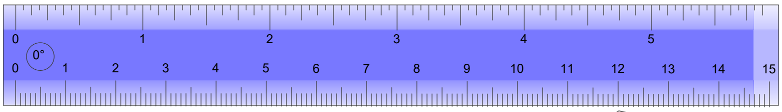
Using a compass and straightedge, copy the following line segments.

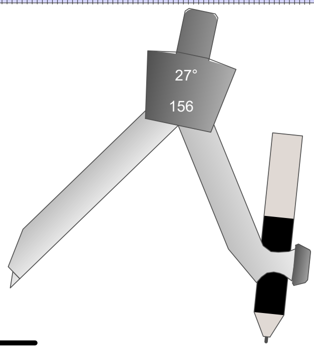


$\overline{XY} \cong \overline{AB}$

ex 1. 

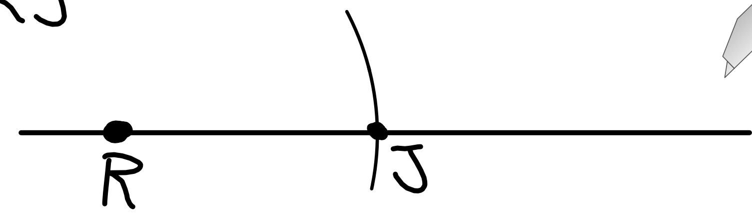






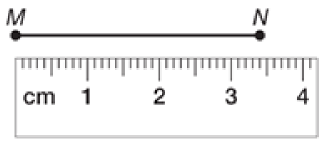
ex.2.

$\overline{XY} \cong \overline{RJ}$



Measure Line Segments A part of a line between two endpoints is called a **line segment.** The lengths of $\overline{MN}$ and $\overline{RS}$ are written as MN and RS. All measurements are approximations dependent upon the smallest unit of measure available on the measuring instrument.

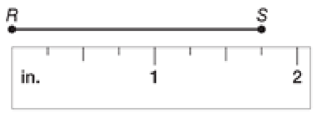
Example 1: Find the length of $\overline{MN}$.



The long marks are centimeters, and the shorter marks are millimeters. There are 10 millimeters for each centimeter. The length of $\overline{MN}$ is about 34 millimeters.

or 3.4 cm

Example 2: Find the length of $\overline{RS}$.



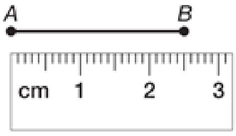
The long marks are inches and the short marks are quarter inches. Point S is closer to the $1\frac{3}{4}$ inch mark. The length of RS is about $1\frac{3}{4}$ inches

or 1.75 in.

Exercises

Find the length of each line segment or object.

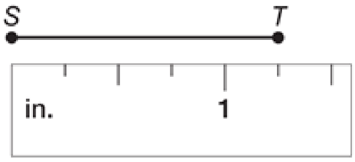
1.



25 mm

2.5 cm

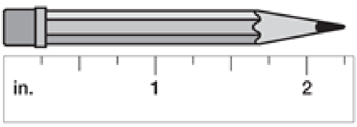
2.



$1\frac{1}{4}$ in

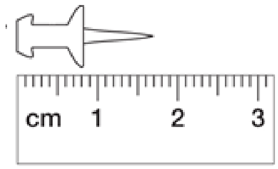
1.25 in

3.



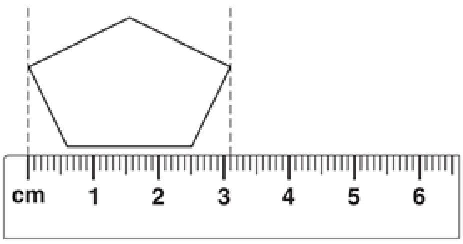
$2\frac{1}{4}$ in
2.25 in

4.



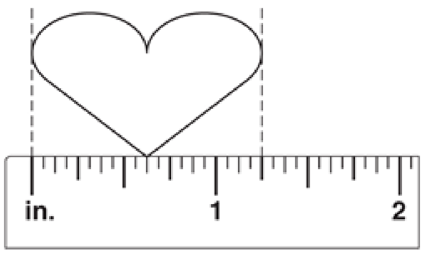
17mm
1.7cm

5.



3.1cm
31mm

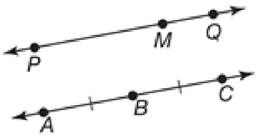
6.



$1\frac{1}{4}$ in
1.25in

segment addition postulate

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



On $\overleftrightarrow{AC}$, $AB = BC = 3$ 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.

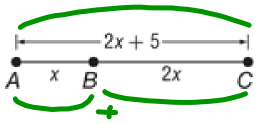
Example 1: Find *EF*.

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

$ED + DF = EF$	Betweenness of points
$1.2 + 1.9 = EF$	Substitution
$3.1 = EF$	Simplify.

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

Example 2: Find *x* and *AC*.



B is between A and C.

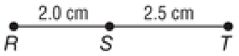
$AB + BC = AC$	Betweenness of points
$x + 2x = 2x + 5$	Substitution
$3x = 2x + 5$	Add $x + 2x$.
$x = 5$	Simplify.

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

Exercises

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

1. $\overline{RT}$

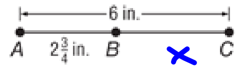


$RS + ST = RT$

$2.0 + 2.5 = RT$

$4.5\text{cm} = RT$

2. $\overline{BC}$



$AB + BC = AC$

$2\frac{3}{4} + x = 6$

$-2\frac{3}{4} \qquad -2\frac{3}{4}$

$x = 3\frac{1}{4}$

$BC = 3\frac{1}{4}$ in.

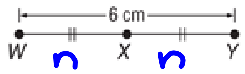
3. $\overline{XZ}$

$XY + YZ = XZ$

$3\frac{1}{2} + \frac{3}{4} = XZ$

$4\frac{1}{4} = XZ$

4. $\overline{WX}$



$\overline{WX} \cong \overline{XY}$

$WX + XY = WY$

$n + n = 6$

$\frac{2n}{2} = \frac{6}{2}$

$n = 3$

$WX = 3\text{cm}$

$RS + ST = RT$

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

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

$RS + ST = RT$

$5x + 3x = 48$

$\frac{8x}{8} = \frac{48}{8}$

$x = 6$

$RS = 5x = 5(6) = 30$

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

$RS + ST = RT$

$2x + 5x + 4 = 32$

$\quad -4 \quad -4$

$\frac{7x}{7} = \frac{28}{7}$

$x = 4$

$RS = 2(4) = 8$

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

$RS + ST = RT$

$6x + 12 = 72$

$-12 \quad -12$

$6x = 60$

$\frac{6x}{6} = \frac{60}{6}$

$x = 10$

$RS = 6(10) = 60$

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

$RS + ST = RT$

$4x + 4x = 24$

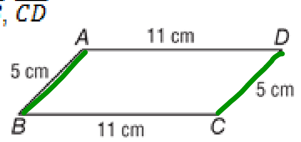
$\frac{8x}{8} = \frac{24}{8}$

$x = 3$

$RS = 4(3) = 12$

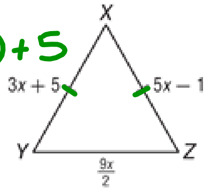
Determine whether each pair of segments is congruent.

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



yes

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



$3(3)+5$

$9+5$

14

no

$\frac{9(3)}{2} = \frac{27}{2}$

13.5

$\overline{XY} \cong \overline{XZ}$

$XY = XZ$

$3x+5 = 5x-1$

$-3x \quad -3x$

$5 = 2x-1$

$+1 \quad +1$

$\frac{6}{2} = \frac{2x}{2}$

$3 = x$