

Lesson 1: Lines and Angles

In this lesson, you will review points and lines. You will also review the different types of angles and determine angle measurements. You will construct congruent segments and angles, bisectors, and parallel lines.

Points, Lines, and Angles

Point (S): a single location, or position, having no size or dimension



Line (\overleftrightarrow{AB} or l): all the points on a straight path that extends infinitely in both directions



Ray (\overrightarrow{AB}): all the points on a straight path that extends infinitely in one direction from an endpoint



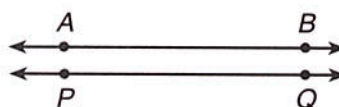
Segment (\overline{AB}): all the points on the straight path between two points, including those two points (endpoints)



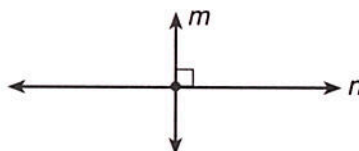
Intersecting lines (j and k): lines that meet at a point



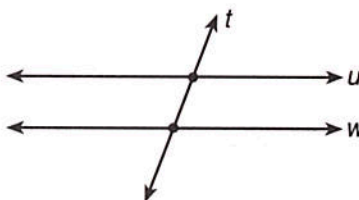
Parallel lines ($\overleftrightarrow{AB} \parallel \overleftrightarrow{PQ}$): lines in the same plane that never intersect and are always the same distance apart



Perpendicular lines ($m \perp n$): lines that meet at a point to form right angles (right angle = 90°)



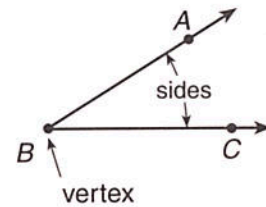
Transversal (t): a line that intersects two or more lines in the same plane at different points



Benchmark Codes: MA.912.G.1.3

Angles

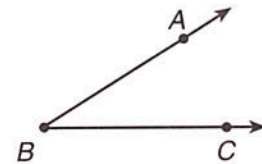
Two rays that share the same endpoint form an **angle**. The shared point is called the **vertex**. The rays are called **sides**. Angles are measured in degrees.



An angle can be named in different ways:

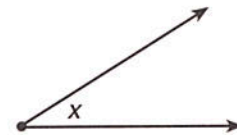
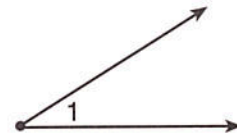
- by the letter of the vertex or by the letters of the three points that form it

$$\angle B, \angle ABC, \text{ or } \angle CBA$$



- by the number or small letter in its interior

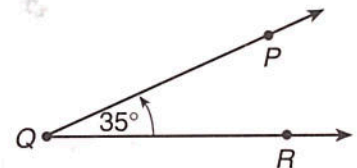
$$\angle 1 \text{ or } \angle x$$



Special Angles

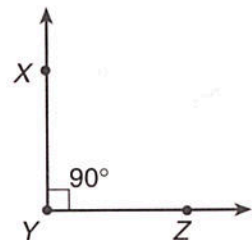
Acute angle: has a measure (m) greater than 0° but less than 90°

$$m\angle PQR = 35^\circ$$



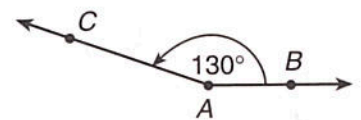
Right angle: has a measure of 90°

$$m\angle XYZ = 90^\circ$$



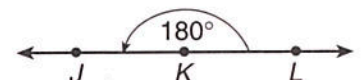
Obtuse angle: has a measure greater than 90° but less than 180°

$$m\angle BAC = 130^\circ$$

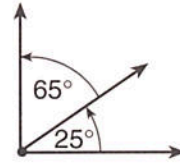


Straight angle: has a measure of 180° ; its sides form a straight line

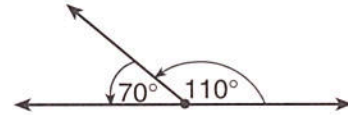
$$m\angle JKL = 180^\circ$$



Complementary angles: two angles whose measures have a sum of 90°

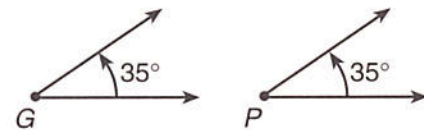


Supplementary angles: two angles whose measures have a sum of 180°



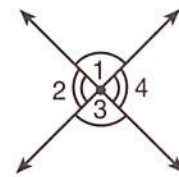
Congruent angles: angles that have the same measure (\cong means congruent)

$$G \cong P$$



Vertical angles: pairs of congruent angles formed by two intersecting lines

$$\angle 1 \cong \angle 3 \quad \angle 2 \cong \angle 4$$



More Special Angles

When two parallel lines (m and n) are cut by a transversal (t), the following relationships occur.

Each pair of **alternate exterior** angles is congruent.

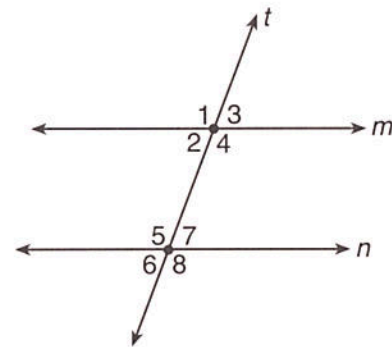
$$\angle 1 \cong \angle 8 \quad \angle 3 \cong \angle 6$$

Each pair of **alternate interior** angles is congruent.

$$\angle 2 \cong \angle 7 \quad \angle 4 \cong \angle 5$$

Each pair of **corresponding** angles is congruent.

$$\begin{aligned} \angle 1 &\cong \angle 5 & \angle 3 &\cong \angle 7 \\ \angle 2 &\cong \angle 6 & \angle 4 &\cong \angle 8 \end{aligned}$$



Each pair of **interior** angles on the **same side** of the transversal is supplementary.

$$m\angle 2 + m\angle 5 = 180^\circ \quad m\angle 4 + m\angle 7 = 180^\circ$$

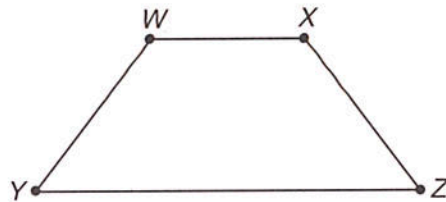
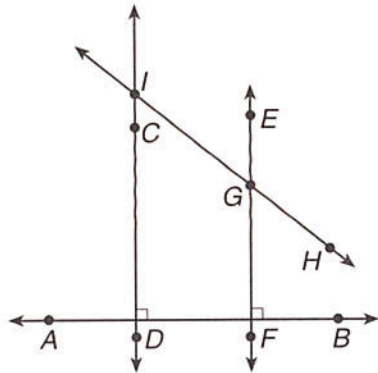
Each pair of **exterior** angles on the **same side** of the transversal is supplementary.

$$m\angle 1 + m\angle 6 = 180^\circ \quad m\angle 3 + m\angle 8 = 180^\circ$$

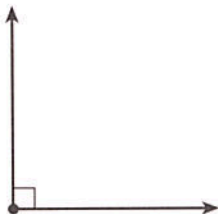
Benchmark Codes: MA.912.G.1.3

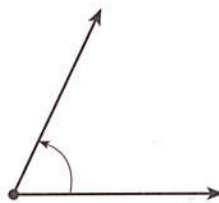
Practice

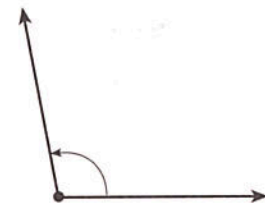
Directions: Use the following two figures to answer questions 1 through 7.



1. $\angle EGH$ and $\angle HGF$ are _____ angles.
If $m\angle EGH = 128^\circ$, $m\angle HGF =$ _____.
2. \overleftrightarrow{AB} is a _____.
3. \overline{WY} is a _____.
4. \overrightarrow{GH} is a _____.
5. Name a pair of parallel lines. _____
6. Name a transversal line. _____
7. \overleftrightarrow{AB} and \overleftrightarrow{CD} are _____ lines.
8. What type of angle is each of the following?

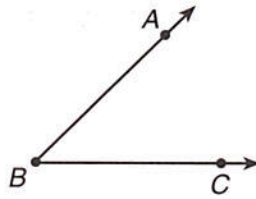






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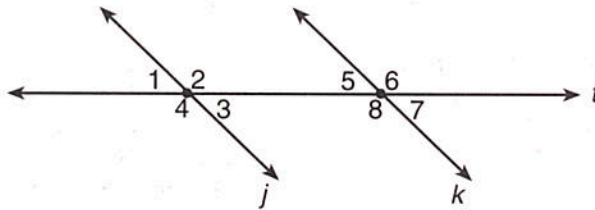
9. Name the angle and vertex in this figure.



angle _____

vertex _____

Directions: In the following figure, lines j and k are parallel and are cut by transversal t . Use the figure to answer questions 10 through 15.



10. List 2 pairs of corresponding angles. _____
11. List 2 pairs of supplementary angles. _____
12. Which pair of angles are alternate interior angles?
- A. $\angle 1$ and $\angle 2$
 B. $\angle 1$ and $\angle 3$
 C. $\angle 2$ and $\angle 5$
 D. $\angle 2$ and $\angle 8$
13. Which pair of angles are alternate exterior angles?
- A. $\angle 4$ and $\angle 6$
 B. $\angle 4$ and $\angle 7$
 C. $\angle 6$ and $\angle 7$
 D. $\angle 6$ and $\angle 8$
14. If $m\angle 2 = 135^\circ$, what is $m\angle 7$?
- A. 35°
 B. 45°
 C. 135°
 D. 145°
15. If $m\angle 1 = 40^\circ$, what is $m\angle 3$?
- A. 150°
 B. 140°
 C. 50°
 D. 40°


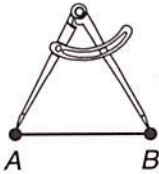

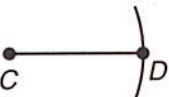
Benchmark Codes: MA.912.G.1.2, MA.912.G.8.6

Constructing Congruent Segments and Angles

When given a segment or angle, you can use a compass to construct a segment or angle that is congruent to the one given.

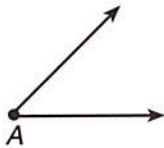
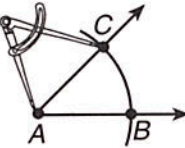
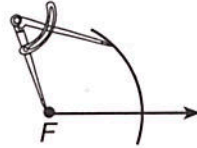
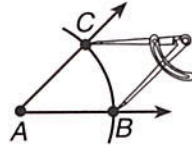
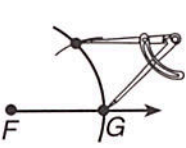
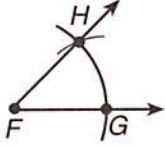
Segments

To draw a segment that is congruent to a given segment, follow these steps:

Given	Step 1	Step 2	Step 3
			
	Open the compass to the exact length of \overline{AB} .	Draw and label point C . With the same opening, place the compass on point C and draw an arc with center C .	Draw and label point D anywhere on that arc. Draw \overline{CD} . $\overline{CD} \cong \overline{AB}$

Angles

To draw an angle that is congruent to a given angle, follow these steps:

Given	Step 1	Step 2	Step 3	Step 4	Step 5
					
	Draw any arc with center A . Draw and label points B and C .	Draw a ray with endpoint F . With same opening, place the compass on point F and draw an arc.	Open the compass to the distance between B and C .	Draw and label point G . With the same opening, place the compass on point G and draw an arc with center G .	Draw and label point H . Draw \overrightarrow{FH} . $\angle GFH \cong \angle BAC$

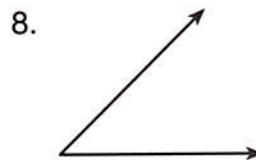
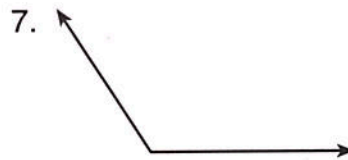
 **TIP:** Constructing line segments and angles is different than drawing or sketching them.

Practice

Directions: For questions 1 through 4, use a compass to draw a segment that is congruent to the one given.



Directions: For questions 5 through 8, use a compass to draw an angle that is congruent to the one given.



Benchmark Codes: MA.912.G.1.2, MA.912.G.8.6

Midpoints and Bisectors

To make constructions, you need to be familiar with a few more geometric terms.

Midpoint of a segment: a point that divides the segment into two equal parts

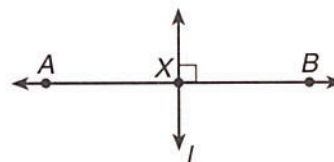
$$\overline{AX} \cong \overline{XB}$$



Perpendicular bisector: a line, ray, or segment that is perpendicular to a segment and divides it into two equal parts

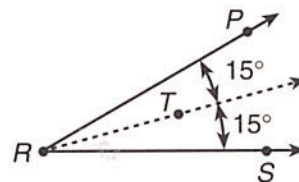
$$l \perp \overline{AB}$$

$$\overline{AX} \cong \overline{XB}$$



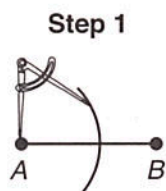
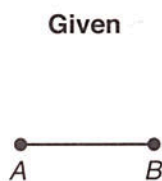
Bisector of an angle: a ray that divides an angle into two congruent angles

$$\overrightarrow{RT} \text{ bisects } \angle PRS$$

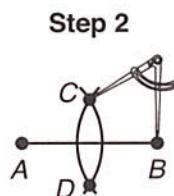


Bisecting a Segment

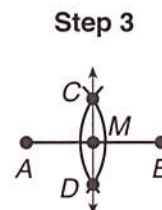
When a bisector is perpendicular (\perp) to the given segment, it is called a **perpendicular bisector**. To draw the perpendicular bisector of a given segment, follow these steps:



Open the compass to more than one half of the length of \overline{AB} and draw an arc with center A .



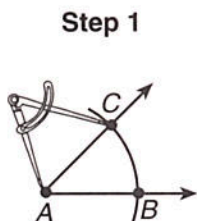
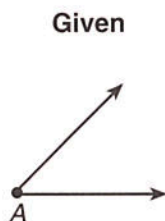
With the same opening, draw an arc with center B . Label the intersections of the arcs C and D .



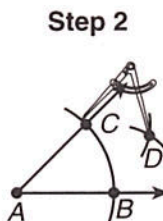
Draw \overleftrightarrow{CD} . Label point M . \overleftrightarrow{CD} is the perpendicular bisector of \overline{AB} . M is the midpoint of \overline{AB} .

Bisecting an Angle

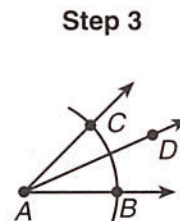
To bisect a given angle, follow these steps:



Draw any arc with center A . Label the intersections of the arc with the sides of the angle B and C .



Open the compass to more than one half of the length of \overline{CB} . Draw an arc with center B . With the same opening, draw an arc with center C . Label the intersection D .



Draw \overrightarrow{AD} . \overrightarrow{AD} bisects $\angle BAC$.

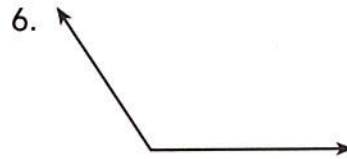
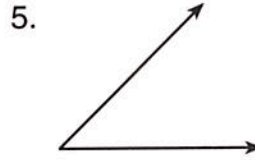
Benchmark Codes: MA.912.G.1.2, MA.912.G.8.6

Practice

Directions: For questions 1 through 4, use a compass to bisect the given segment.



Directions: For questions 5 through 8, use a compass to bisect the given angle.



Constructing Parallel Lines

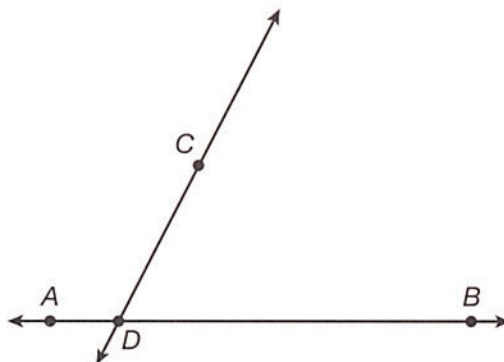
When given a line or line segment, you can use a straightedge and a compass to draw a parallel line or line segment.

Example

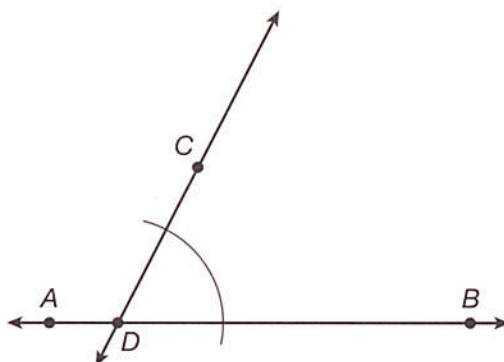
Draw a line that is parallel to \overleftrightarrow{AB}



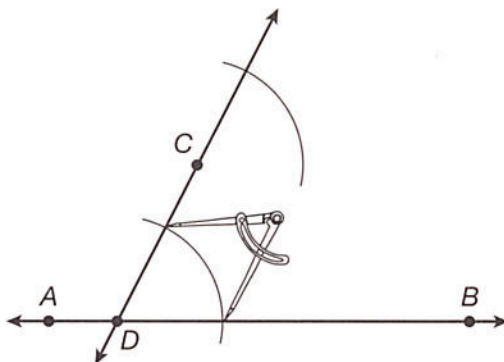
First, draw a point above the line and use a straightedge to create a new line that intersects \overleftrightarrow{AB} at an angle. The new point will be point C . The line from point C intersects \overleftrightarrow{AB} at point D .



Once an intersecting line, \overleftrightarrow{CD} , has been drawn, use the compass to draw an arc across both lines, centered on point D .

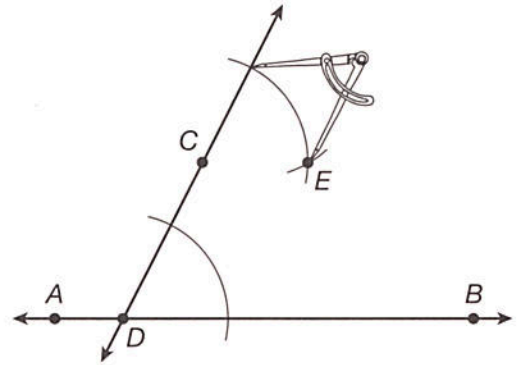


Keeping the same angle on the compass, draw an arc around point C . Make sure that the arc goes through the line and extends below point C .

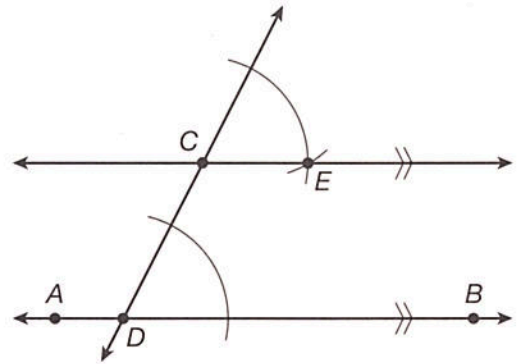


Benchmark Codes: MA.912.G.1.2, MA.912.G.8.6

Next, open the compass to the distance between the intersection of the arc around point D with the line AB and with the same arc with the line CD . Using this width, bring the point of the compass to where the upper arc intersects line CD and draw an arc so that it crosses the upper arc. Draw a point at that intersection, point E .



Use a straightedge form \overleftrightarrow{CE} .



Two lines with a transversal are parallel only when corresponding angles are congruent. The previous example creates a parallel line by constructing a congruent angle along a transversal. The angle constructed with vertex C is congruent to $\angle CDB$ and forms a corresponding angle. Therefore, $\overleftrightarrow{AB} \parallel \overleftrightarrow{CE}$.

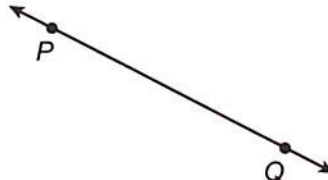
Practice

Directions: For questions 1 through 6, use a compass and a straightedge to draw a line that is parallel to the one given.

1.



4.



2.



5.



3.



6.

