Section 14.3: Constructions

**CONSTRUCTION 1:** Construct a line segment equal in length to a given line segment.

1. Let $\overline{AB}$ be the given line segment. Adjust the radius of the compass to the length of $\overline{AB}$ by putting the metal point on $A$ and the pencil point on $B$.

2. Draw a line $\ell$ and mark a point on it (point $C$ in the figure). Draw an arc with center $C$ and radius $AB$ that intersects the line (in the figure, the arc intersects $\ell$ in point $D$). $CD = AB$.

**Example 1.** Construct a line segment equal in length to $AB$. 
CONSTRUCTION 2: To bisect a line segment.

1. Let $\overline{AB}$ be the given line segment.

2. With $A$ and $B$ as centers, draw two arcs that have the same radius and that intersect each other in two points ($C$ and $D$ in the figure).

3. Draw $\overrightarrow{CD}$. $\overrightarrow{CD}$ bisects $\overline{AB}$.

Example 2. Bisect the following line segment.
CONSTRUCTION 3: To construct the line perpendicular to a given line through a point on it.

1. Let $\ell$ be the given line and $P$ a point on it.

2. With $P$ as center, draw an arc that intersects $\ell$ in two points ($A$ and $B$ in the figure). Note that $P$ is equidistant from $A$ and $B$.

3. Use your compass to locate another point that is equidistant from $A$ and $B$. ($C$ in the figure).

4. Draw $\overrightarrow{CP}$.

Example 3. Construct a line perpendicular to the given line through the point $P$. 

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CONSTRUCTION 4: To construct the line perpendicular to a given line through a point not on it.

1. Let $\ell$ be the given line and $P$ be a point not on it. The steps in the procedure, illustrated below, are similar to those in Construction 3.

Example 4. Construct the line perpendicular to the given line through $P$. 
CONSTRUCTION 5: To construct an angle equal in measure to a given angle.

1. Let $\angle A$ be the given angle.
2. Draw a ray $\overrightarrow{BC}$ as one side of the angle to be constructed.

3. With $A$ as center, draw an arc that intersects the sides of $\angle A$ (points $D$ and $E$ in the figure at the left below).
4. Draw an arc with the same radius and with $B$ as center that intersects $\overrightarrow{BC}$ (point $F$ in the figure at the right below).

5. Adjust the radius of the compass to the distance between points $D$ and $E$.
6. With $F$ as center, draw an arc having this radius so that it intersects the previous one (point $G$ in the figure).

7. Draw $\overrightarrow{BG}$. $\angle B = \angle A$.

Example 5. Construct an angle equal in measure to angle $A$. 
**CONSTRUCTION 6:** To bisect an angle.

1. Let \( \angle A \) be the given angle.

2. With \( A \) as center, draw an arc that intersects the sides of the angle (points \( B \) and \( C \) in the figure).

3. With \( B \) and \( C \) as centers, draw two arcs that have the same radius and that intersect each other in a point inside the angle (point \( D \) in the figure).

4. Draw \( \overrightarrow{AD} \). \( \overrightarrow{AD} \) bisects the angle.

**Example 6.** Bisect the given angle.
CONSTRUCTION 7: To construct the line parallel to a given line through a point not on it.

Let \( \ell \) be the given line and \( P \) a point not on it. Choose any point \( A \) on the line \( \ell \) and draw \( \overrightarrow{PA} \). Name one of the angles formed at \( A \) \( \angle 1 \) as shown in the second figure below. At \( P \), construct an angle equal in measure to \( \angle 1 \) as shown in the third figure below. Name it \( \angle 2 \). Because \( \angle 1 \) and \( \angle 2 \) are equal corresponding angles formed by lines \( m \) and \( \ell \) and transversal \( \overrightarrow{PA} \), \( m \parallel \ell \).

Example 7. Construct a line parallel to the given line through \( P \).