# Writing Proofs

Jonathan R. Bacolod

Sauyo High School

# What is a Proof?

Proof: a form of logical reasoning in which each statement is organized and backed up by the reasons

# What are the Ways of Writing Proofs?

# What are the Ways of Writing Proofs?

1. Flow-Chart Proof

# What are the Ways of Writing Proofs?

1. Flow-Chart Proof
2. Two-Column Proof

# What are the Ways of Writing Proofs?

1. Flow-Chart Proof
2. Two-Column Proof
3. Paragraph Form Proof

# Definitions of Geometric Terms

# Definitions of Geometric Terms

1. Definition of Betweenness: If $B$ is between $\overline{AC}$, then $AC = AB + BC$.

# Definitions of Geometric Terms

1. Definition of Betweenness: If $B$ is between $\overline{AC}$, then $AC = AB + BC$.
2. Midpoint: If $B$ is the midpoint of $\overline{AC}$, then $AB = BC$.

# Definitions of Geometric Terms

1. Definition of Betweenness: If $B$ is between $\overline{AC}$, then $AC = AB + BC$.
2. Midpoint: If $B$ is the midpoint of $\overline{AC}$, then $AB = BC$.
3. Segment Bisector: If a line, ray or another segment bisects the segment $\overline{AB}$ at $X$, then $\overline{AX} \cong \overline{BX}$.

# Definitions of Geometric Terms

1. Definition of Betweenness: If $B$ is between $\overline{AC}$, then $AC = AB + BC$.
2. Midpoint: If $B$ is the midpoint of $\overline{AC}$, then $AB = BC$.
3. Segment Bisector: If a line, ray or another segment bisects the segment $\overline{AB}$ at $X$, then $\overline{AX} \cong \overline{BX}$.
4. Right Angle: If $\angle A$ is a right angle, then $m\angle A = 90^\circ$.

# Definitions of Geometric Terms

1. Definition of Betweenness: If $B$ is between $\overline{AC}$, then $AC = AB + BC$.
2. Midpoint: If $B$ is the midpoint of $\overline{AC}$, then $AB = BC$.
3. Segment Bisector: If a line, ray or another segment bisects the segment $\overline{AB}$ at $X$, then $\overline{AX} \cong \overline{BX}$.
4. Right Angle: If $\angle A$ is a right angle, then $m\angle A = 90^\circ$.
5. Perpendicular Line Segments: If $\overline{AB} \perp \overline{AC}$, then $\angle BAC$ is a right angle.

# Definitions of Geometric Terms

1. Definition of Betweenness: If $B$ is between $\overline{AC}$, then $AC = AB + BC$.
2. Midpoint: If $B$ is the midpoint of $\overline{AC}$, then $AB = BC$.
3. Segment Bisector: If a line, ray or another segment bisects the segment $\overline{AB}$ at $X$, then $\overline{AX} \cong \overline{BX}$.
4. Right Angle: If $\angle A$ is a right angle, then $m\angle A = 90°$.
5. Perpendicular Line Segments: If $\overline{AB} \perp \overline{AC}$, then $\angle BAC$ is a right angle.
6. Complementary Angles: If $\angle A$ and $\angle B$ are complementary angles, then $m\angle A + m\angle B = 90°$.

# Definitions of Geometric Terms

# Definitions of Geometric Terms

7. Supplementary Angles: If $\angle A$ and $\angle B$ are supplementary angles, then $m\angle A + m\angle B = 180^\circ$.

# Definitions of Geometric Terms

7. Supplementary Angles: If $\angle A$ and $\angle B$ are supplementary angles, then $m\angle A + m\angle B = 180^\circ$.
8. Linear Pair: If two angles are adjacent such that two of the rays are opposite, then they form a linear pair.

# Definitions of Geometric Terms

7. Supplementary Angles: If $\angle A$ and $\angle B$ are supplementary angles, then $m\angle A + m\angle B = 180^\circ$.
8. Linear Pair: If two angles are adjacent such that two of the rays are opposite, then they form a linear pair.
9. Definition of Congruent Segments: If $\overline{AB} \cong \overline{CD}$, then $AB = CD$.

# Definitions of Geometric Terms

7. Supplementary Angles: If $\angle A$ and $\angle B$ are supplementary angles, then $m\angle A + m\angle B = 180^\circ$.
8. Linear Pair: If two angles are adjacent such that two of the rays are opposite, then they form a linear pair.
9. Definition of Congruent Segments: If $\overline{AB} \cong \overline{CD}$, then $AB = CD$.
10. Definition of Congruent Angles: If $\angle A \cong \angle B$, then $m\angle A = m\angle B$.

# Properties of Equality

# Properties of Equality

1. Addition Property of Equality: If $a = b$, then $a + c = b + c$.

# Properties of Equality

1. Addition Property of Equality: If $a = b$, then $a + c = b + c$.
2. Subtraction Property of Equality: If $a = b$, then $a - c = b - c$.

# Properties of Equality

1. Addition Property of Equality: If $a = b$, then $a + c = b + c$.
2. Subtraction Property of Equality: If $a = b$, then $a - c = b - c$.
3. Multiplication Property of Equality: If $a = b$, then $ac = bc$.

# Properties of Equality

1. Addition Property of Equality: If $a = b$, then $a + c = b + c$.
2. Subtraction Property of Equality: If $a = b$, then $a - c = b - c$.
3. Multiplication Property of Equality: If $a = b$, then $ac = bc$.
4. Division Property of Equality: If $a = b$ and $c \neq 0$, then $\dfrac{a}{c} = \dfrac{b}{c}$.

# Properties of Equality

# Properties of Equality

5. Reflexive Property of Equality: If $a$ is any real number, then $a = a$.

# Properties of Equality

5. Reflexive Property of Equality: If $a$ is any real number, then $a = a$.
6. Symmetric Property: If $a = b$,then $b = a$.

# Properties of Equality

5. Reflexive Property of Equality: If $a$ is any real number, then $a = a$.
6. Symmetric Property: If $a = b$,then $b = a$.
7. Transitive Property: If $a = b$ and $b = c$, then $a = c$.

# Properties of Equality

5. Reflexive Property of Equality: If $a$ is any real number, then $a = a$.
6. Symmetric Property: If $a = b$,then $b = a$.
7. Transitive Property: If $a = b$ and $b = c$, then $a = c$.
8. Substitution Property: If $a + b = c$ and $b = x$, then $a + x = c$.

# Properties of Congruence

# Properties of Congruence

1. Reflexive Property of Equality: Any angle or segment is congruent to itself ($\overline{AB} \cong \overline{AB}$).

# Properties of Congruence

1. Reflexive Property of Equality: Any angle or segment is congruent to itself ($\overline{AB} \cong \overline{AB}$).
2. Symmetric Property: If $\angle A \cong \angle B$, then $\angle B \cong \angle A$.

# Properties of Congruence

1. Reflexive Property of Equality: Any angle or segment is congruent to itself ($\overline{AB} \cong \overline{AB}$).
2. Symmetric Property: If $\angle A \cong \angle B$, then $\angle B \cong \angle A$.
3. Transitive Property: If $\angle A \cong \angle B$ and $\angle B \cong \angle C$, then $\angle A \cong \angle C$.

# Example 1

Provide the reason for each statement.

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
    - Definition of Right Angle

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
   - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180^\circ$.

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
   - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180^\circ$.
   - Definition of Supplementary Angles

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
    - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180^\circ$.
    - Definition of Supplementary Angles
3. If $Y$ is the midpoint of $\overline{CE}$ then $CY = EY$.

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
   - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180^\circ$.
   - Definition of Supplementary Angles
3. If $Y$ is the midpoint of $\overline{CE}$ then $CY = EY$.
   - Definition of Midpoint

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
   - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180^\circ$.
   - Definition of Supplementary Angles
3. If $Y$ is the midpoint of $\overline{CE}$ then $CY = EY$.
   - Definition of Midpoint
4. If $\overline{LO} \cong \overline{VE}$, then $LO = VE$.

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90°$.
   - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180°$.
   - Definition of Supplementary Angles
3. If $Y$ is the midpoint of $\overline{CE}$ then $CY = EY$.
   - Definition of Midpoint
4. If $\overline{LO} \cong \overline{VE}$, then $LO = VE$.
   - Definition of Congruent Segments

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
   - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180^\circ$.
   - Definition of Supplementary Angles
3. If $Y$ is the midpoint of $\overline{CE}$ then $CY = EY$.
   - Definition of Midpoint
4. If $\overline{LO} \cong \overline{VE}$, then $LO = VE$.
   - Definition of Congruent Segments
5. If $2x = 10$ then $\dfrac{2x}{2} = \dfrac{10}{2}$.

# Example 1

Provide the reason for each statement.

1. If $\angle 1$ is a right angle, then $m\angle 1 = 90^\circ$.
   - Definition of Right Angle
2. If $\angle M$ and $\angle N$ are supplementary, then $m\angle M + m\angle N = 180^\circ$.
   - Definition of Supplementary Angles
3. If $Y$ is the midpoint of $\overline{CE}$ then $CY = EY$.
   - Definition of Midpoint
4. If $\overline{LO} \cong \overline{VE}$, then $LO = VE$.
   - Definition of Congruent Segments
5. If $2x = 10$ then $\dfrac{2x}{2} = \dfrac{10}{2}$.
   - Division Property of Equality

# Example 1

Provide the reason for each statement.

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
    - Addition Property of Equality

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.
   - Definition of Segment Bisector

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.
   - Definition of Segment Bisector
8. If $x + y = 12$ and $y = 9$, then $x + 9 = 12$.

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.
   - Definition of Segment Bisector
8. If $x + y = 12$ and $y = 9$, then $x + 9 = 12$.
   - Substitution Property

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.
   - Definition of Segment Bisector
8. If $x + y = 12$ and $y = 9$, then $x + 9 = 12$.
   - Substitution Property
9. If $AB + BC = 2AB$ and $2AB = AC$, then $AB + BC = AC$.

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.
   - Definition of Segment Bisector
8. If $x + y = 12$ and $y = 9$, then $x + 9 = 12$.
   - Substitution Property
9. If $AB + BC = 2AB$ and $2AB = AC$, then $AB + BC = AC$.
   - Transitive Property

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.
   - Definition of Segment Bisector
8. If $x + y = 12$ and $y = 9$, then $x + 9 = 12$.
   - Substitution Property
9. If $AB + BC = 2AB$ and $2AB = AC$, then $AB + BC = AC$.
   - Transitive Property
10. If $\angle X \cong \angle Y$, then $\angle Y \cong \angle X$.

# Example 1

Provide the reason for each statement.

6. If $2x - 3 = 5$, then $2x - 3 + 3 = 5 + 3$.
   - Addition Property of Equality
7. If $\overrightarrow{LM}$ bisects $\overline{PG}$ at $L$, then $\overline{LP} \cong \overline{GL}$.
   - Definition of Segment Bisector
8. If $x + y = 12$ and $y = 9$, then $x + 9 = 12$.
   - Substitution Property
9. If $AB + BC = 2AB$ and $2AB = AC$, then $AB + BC = AC$.
   - Transitive Property
10. If $\angle X \cong \angle Y$, then $\angle Y \cong \angle X$.
    - Symmetric Property

# What is a Postulate?

Postulate: a statement that is accepted without proof

# Some Postulates in Geometry

# Some Postulates in Geometry

1. Linear Pair Postulate: If two angles form a linear pair, then they are supplementary.

# Some Postulates in Geometry

1. Linear Pair Postulate: If two angles form a linear pair, then they are supplementary.
2. Segment Addition Postulate: If $B$ lies on $\overline{AC}$, then $AC = AB + BC$.

# Some Postulates in Geometry

1. Linear Pair Postulate: If two angles form a linear pair, then they are supplementary.
2. Segment Addition Postulate: If $B$ lies on $\overline{AC}$, then $AC = AB + BC$.
3. Angle Addition Postulate: If $B$ is in the interior of $\angle AOC$, then $m\angle AOC = m\angle AOB + m\angle BOC$.

# What is a Theorem?

Theorem: a statement that is accepted after it is proved deductively

# Some Theorems in Geometry

# Some Theorems in Geometry

1. Vertical Angle Theorem: If two angles are vertical, then they are congruent.

# Some Theorems in Geometry

1. Vertical Angle Theorem: If two angles are vertical, then they are congruent.
2. Complement Theorem: If two angles are complement of the same (or congruent) angles, then they are congruent.

# Some Theorems in Geometry

1. Vertical Angle Theorem: If two angles are vertical, then they are congruent.
2. Complement Theorem: If two angles are complement of the same (or congruent) angles, then they are congruent.
3. Supplement Theorem: If two angles are supplement of the same (or congruent) angles, then they are congruent.

# Example 2

Provide the reason for each statement.

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
    - Vertical Angle Theorem

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.
   - Linear Pair Postulate

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.
   - Linear Pair Postulate
3. If $m\angle J + m\angle K = 90^\circ$ and $m\angle K + m\angle L = 90^\circ$, then $\angle J \cong \angle L$.

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.
   - Linear Pair Postulate
3. If $m\angle J + m\angle K = 90^\circ$ and $m\angle K + m\angle L = 90^\circ$, then $\angle J \cong \angle L$.
   - Complement Theorem

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.
   - Linear Pair Postulate
3. If $m\angle J + m\angle K = 90^\circ$ and $m\angle K + m\angle L = 90^\circ$, then $\angle J \cong \angle L$.
   - Complement Theorem
4. If $Y$ lies on $\overline{XZ}$, then $XZ = XY + YZ$.

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.
   - Linear Pair Postulate
3. If $m\angle J + m\angle K = 90^\circ$ and $m\angle K + m\angle L = 90^\circ$, then $\angle J \cong \angle L$.
   - Complement Theorem
4. If $Y$ lies on $\overline{XZ}$, then $XZ = XY + YZ$.
   - Segment Addition Postulate

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.
   - Linear Pair Postulate
3. If $m\angle J + m\angle K = 90^\circ$ and $m\angle K + m\angle L = 90^\circ$, then $\angle J \cong \angle L$.
   - Complement Theorem
4. If $Y$ lies on $\overline{XZ}$, then $XZ = XY + YZ$.
   - Segment Addition Postulate
5. If $m\angle D + m\angle E = 180^\circ$ and $m\angle E + m\angle F = 180^\circ$, then $\angle D \cong \angle F$.

# Example 2

Provide the reason for each statement.

1. If $\angle X$ and $\angle Y$ are vertical angles, then $\angle X \cong \angle Y$.
   - Vertical Angle Theorem
2. If $\angle M$ and $\angle N$ form a linear pair, then $\angle M$ and $\angle N$ are supplementary.
   - Linear Pair Postulate
3. If $m\angle J + m\angle K = 90^\circ$ and $m\angle K + m\angle L = 90^\circ$, then $\angle J \cong \angle L$.
   - Complement Theorem
4. If $Y$ lies on $\overline{XZ}$, then $XZ = XY + YZ$.
   - Segment Addition Postulate
5. If $m\angle D + m\angle E = 180^\circ$ and $m\angle E + m\angle F = 180^\circ$, then $\angle D \cong \angle F$.
   - Supplement Theorem

Thank you for watching.