



**IDX G9 Math S**  
**Study Guide Issue Semester 1 Final**  
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**Unit 2 Triangles**

**1. Triangle Basics & Classification**

- Types of Triangles (by sides)
  - **Scalene** – no congruent sides
  - **Isosceles** – at least two congruent sides
  - **Equilateral** – all three sides congruent
- Types of Triangles (by angles)
  - **Acute** – all angles  $< 90^\circ$
  - **Right** – one  $90^\circ$  angle
  - **Obtuse** – one angle  $> 90^\circ$
  - **Equiangular** – all angles congruent (always  $60^\circ$  each)

**2. Triangle Angle-Sum & Exterior Angle Theorems**

- **Triangle Angle-Sum Theorem (Th 3-12)**
  - The interior angles of a triangle add up to  $180^\circ$
- **Exterior Angle Theorem (Th 3-13)**

- An **exterior angle** equals the **sum of the two remote interior angles**
- Example: If two angles are known, subtract from  $180^\circ$  to find the third.

### 3. Congruent Figures & Corresponding Parts

- **Congruent polygons** – same shape and size
- **Corresponding sides/angles/vertices** – matching parts of congruent figures

#### Important Rule (Th 4-1)

- If two angles of one triangle are congruent to two angles of another triangle, the triangles are **similar, not necessarily congruent**.

### 4. Triangle Congruence Shortcuts

- To prove triangles congruent
  - **SSS (Side-Side-Side)**
    - All three corresponding sides are congruent **Postulate 4-1 (SSS)**
  - **SAS (Side-Angle-Side)**
    - Two sides and the included angle congruent **Postulate 4-2 (SAS)**
  - **ASA (Angle-Side-Angle)**
    - Two angles and included side congruent **Postulate 4-3 (ASA)**
  - **HL Theorem (SAS)**
    - Two angles and a non-included side
    - **Can only be used in proving Right Triangles Congruent!**

### 5. CPCTC

- **CPCTC = Corresponding Parts of Congruent Triangles are Congruent**
- Once two triangles are proven congruent, you can conclude:
  - Corresponding sides are equal
  - Corresponding angles are equal

### 6. Congruence in Right Triangles

- **HL (Hypotenuse-Leg) Theorem**
  - Applies **only to right triangles**
    - Hypotenuse  $\cong$  Hypotenuse
    - One leg  $\cong$  one leg

- Angle  $\cong$  Angle (Already given because it's a right triangle) Then you can prove triangles congruent

## 7. Isosceles & Equilateral Triangle Theorems

- **Isosceles Triangle Theorem**
  - If two sides are congruent  $\rightarrow$  base angles are congruent (Th 4-3)
- **Converse of Isosceles Triangle Theorem**
  - If base angles are congruent  $\rightarrow$  sides are congruent (Th 4-4)
- The vertex angle bisector is also the:
  - Median
  - Altitude
  - Perpendicular bisector (Th 4-5)
- **Equilateral Triangle Facts**
  - All sides congruent
  - All angles congruent (each  $60^\circ$ )
  - Equilateral  $\Rightarrow$  equiangular
  - Equiangular  $\Rightarrow$  equilateral (corollaries)

## 8. Inequalities in Triangles

- **Exterior Angle Inequality**
  - An exterior angle is **greater than either remote interior angle**
- **Longer Side–Larger Angle Relationship Th 5-10**
  - Larger side  $\Leftrightarrow$  larger opposite angle
- **Larger Angle–Longer Side Th 5-11 (Converse)**
  - Larger angle  $\Leftrightarrow$  longer opposite side
- **Triangle Inequality Theorem (Th 5-12)**
  - Sum of any two sides must be **greater than the third side**
  - Examples:
    - $a + b > c$
    - $a + c > b$
    - $b + c > a$

## 9. Bisectors in Triangles

- **Perpendicular Bisector Theorem (Th 5-2)**
  - A point on a perpendicular bisector is **equidistant from endpoints**
- **Converse of Perpendicular Bisector Theorem (Th 5-3)**
  - If a point is equidistant from the endpoints → it lies on the perpendicular bisector
- **Angle Bisector Theorem (Th 5-4)**
  - Point on an angle bisector is **equidistant from the sides of the angle**
- **Converse of Angle Bisector Theorem (Th 5-5)**
  - If a point is equidistant from the sides of the angles → It lies on the angle bisector

## 10. Special Triangle Lines

- **Medians**
  - Connect a **vertex to the midpoint of the opposite side**
- **Altitudes**
  - A **perpendicular segment** from a vertex to the opposite side

## Centers of a Triangle

Center	Definition
<b>Circumcenter</b>	Intersection of perpendicular bisectors
<b>Incenter</b>	Intersection of angle bisectors
<b>Centroid</b>	Intersection of medians
<b>Orthocenter</b>	Intersection of altitudes

- **Concurrency Theorems**
  - Perpendicular bisectors meet at circumcenter (Th 5-6)
  - Angle bisectors meet at incenter (Th 5-7)
  - Medians meet at centroid (Th 5-8) and are in a **2:1 ratio** from vertex
  - Altitudes meet at orthocenter (Th 5-9)

## 11. Constructions (Compass & Straightedge)

- You should be able to construct:
  - Congruent segments
  - Congruent angles
  - Perpendicular bisectors
  - Angle bisectors
  - Parallel and perpendicular lines

### Unit 3 Polygons

#### 3.5 Concepts & Properties of Polygons / Polygon Angle-Sum Theorems

- *Polygon:*
  - Closed plane figure with  $\geq 3$  sides
  - Sides intersect only at endpoints
  - No adjacent sides collinear
- *Classification:*
  - **By shape:** Convex (all interior angles  $< 180^\circ$ ), Concave (some angles  $> 180^\circ$ )
  - **By sides:** Triangle (3), Quadrilateral (4), Pentagon (5), Hexagon (6), Heptagon (7), Octagon (8), Nonagon (9), Decagon (10), n-gon
  - **Special polygons:** Equilateral (all sides equal), Equiangular (all angles equal), Regular (both equilateral and equiangular)
- *Theorems & Formulas:*
  - **Interior angles sum:**  $((n-2) \cdot 180^\circ)$
  - **Exterior angles sum:**  $360^\circ$
  - **Interior angle of regular polygon:**  $((n-2) \cdot 180/n)$
  - **Exterior angle of regular polygon:**  $(360/n)$
  - **Diagonals from one vertex:**  $(n-3)$

#### 6.1 Classifying Quadrilaterals

- *Quadrilateral Types:*
  - **Parallelogram:** opposite sides parallel
  - **Rectangle:** parallelogram with 4 right angles
  - **Rhombus:** parallelogram with 4 congruent sides
  - **Square:** parallelogram with 4 right angles + 4 congruent sides
  - **Isosceles trapezoid:** one pair of parallel sides; nonparallel sides congruent
  - **Kite:** two pairs of adjacent sides congruent, no opposite sides congruent
- *Properties:*
  - Interior angles sum =  $360^\circ$
  - Opposite sides congruent (**parallelogram**)
  - Opposite angles congruent (**parallelogram**)
  - Consecutive angles supplementary (**parallelogram**)
  - Diagonals bisect each other (**parallelogram**)
- *Special diagonal properties:*
  - **Rhombus:** perpendicular, bisect angles
  - **Rectangle:** congruent
  - **Square:** perpendicular + congruent

## 6.2 Properties of Parallelograms

- *Theorems:*
  - **Opposite sides are congruent**
  - **Opposite angles are congruent**
  - **Consecutive angles are supplementary**
  - **Diagonals bisect each other**

## 6.3 Proving a Quadrilateral is a Parallelogram

- *Methods:*
  - Both pairs of opposite sides congruent
  - Both pairs of opposite angles congruent
  - Diagonals bisect each other
  - One pair of opposite sides parallel and congruent

## 6.4 Special Parallelograms

- *Definitions:*
  - **Rhombus:** 4 congruent sides
  - **Rectangle:** 4 right angles
  - **Square:** 4 congruent sides + 4 right angles
- *Diagonal Properties:*
  - **Rhombus:** diagonals perpendicular, bisect angles
  - **Rectangle:** diagonals congruent
  - **Square:** diagonals perpendicular + congruent
- *Converse Theorems:*
  - Diagonal bisects two angles → **rhombus**
  - Diagonals congruent → **rectangle**

## 6.5 Trapezoids and Kites

- *Trapezoids:*
  - One pair of parallel sides
  - **Isosceles trapezoid:** nonparallel sides congruent; base angles congruent
  - **Diagonals of isosceles trapezoid:** congruent

- ***Kites:***
  - Two pairs of adjacent sides congruent, no opposite sides congruent
  - Diagonals perpendicular; one diagonal bisects the other

## 5.1 Midsegments of Triangles

- ***Theorem:***
  - Segment connecting midpoints of two sides is parallel to third side
  - Length =  $\frac{1}{2}$  third side
- ***Coordinate Geometry:***
  - **Midpoint formula:**  $(\frac{X_1+X_2}{2}, \frac{Y_1+Y_2}{2})$
  - **Slope formula:** parallel segments
  - **Distance formula:** segment length

## 7.1 Ratios and Proportions

- ***Concepts:***
  - Ratio:  $a:b = a/b$
  - Proportion:  $a/b = c/d \rightarrow$  cross product:  $ad = bc$
  - Scale drawing: use ratio to calculate actual lengths

## 7.2 Similar Polygons

- ***Definition:***
  - Polygons are similar if corresponding angles congruent and sides proportional



- *Similarity Ratio:*
  - Ratio of corresponding sides
  - **Golden rectangle: length:width = 1.618:1**

### 7.3 Proving Triangles Similar

- *Methods:*
  - **AA~**: two angles congruent
  - **SAS~**: included angle congruent, sides proportional
  - **SSS~**: all sides proportional

### 7.4 Similarity in Right Triangles

- *Geometric Mean Theorems:*
  - **Altitude to hypotenuse:**  $AD^2 = BD \times DC \rightarrow AD = \text{geometric mean}$
  - **Leg theorem:**  $AC^2 = AB \times AD \rightarrow AC = \text{geometric mean}$
- *Proportion Properties:*
  - Means and extremes for similar triangles
  - Use geometric mean to solve for unknown sides