



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° angle
 - **Obtuse** – one angle $> 90^\circ$
 - **Equiangular** – all angles congruent (always 60° 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°
- **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° 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°)
 - 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 \Rightarrow larger opposite angle
- **Larger Angle–Longer Side Th 5-11 (Converse)**
 - Larger angle \Rightarrow 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
Circumcenter	Intersection of perpendicular bisectors
Incenter	Intersection of angle bisectors
Centroid	Intersection of medians
Orthocenter	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 ≥ 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°
 - **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°
 - 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