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Measuring Line Segments

A line segment is a fixed portion of a line with two endpoints. The length of a line segment is the distance between its endpoints and is a unique positive number. Measuring line segments allows us to compare their lengths precisely.

Methods of Comparing Line Segments

- **Comparison by Observation:** Visual inspection to judge which segment is longer. This method is not always reliable for close lengths.
- **Comparison by Tracing:** Using tracing paper to overlay one segment on another to compare lengths. Accuracy depends on tracing precision.
- **Comparison using Ruler and Divider:** Using a ruler to measure lengths directly and a divider to transfer lengths for comparison.

Using a Ruler

A ruler is marked with units such as centimeters (cm) and millimeters (mm). 1 cm = 10 mm. To measure a line segment:

1. Place the zero mark of the ruler at one endpoint.
2. Read the mark on the ruler at the other endpoint.
3. The reading gives the length of the segment in cm and mm.

Example: If the reading is 5.8 cm, the length is 5 cm and 8 mm.

Using a Divider

A divider has two pointed arms. To measure a segment:

1. Open the divider so that its arms touch the endpoints of the segment.
2. Without changing the opening, place one arm at zero on the ruler.
3. Read the length on the ruler at the other arm.

Worked Example

Measure the length of a postcard side using a ruler and a divider.

1. Place the zero mark of the ruler at one corner of the postcard side.
2. Note the reading at the other corner; suppose it is 12.3 cm.
3. Open the divider to match the postcard side length.
4. Transfer the divider to the ruler and confirm the length is 12.3 cm.

Practice Set

- **Level 1 – Easy:** Measure the length of your pencil using a ruler.
- **Level 2 – Moderate:** Use a divider to measure and compare the lengths of two different books.
- **Level 3 – Challenging:** Measure the perimeter of a triangular table using a ruler and divider.

Answer Key

- Level 1: Length varies; example 15 cm.
- Level 2: Compare lengths by transferring divider measurements; longer book has greater length.
- Level 3: Sum of three measured sides; e.g., 120 cm.

Quick Reference

- 1 cm = 10 mm
- Use zero mark of ruler at one endpoint

- Use divider to transfer lengths accurately

Glossary

- **Line Segment:** Part of a line with two endpoints.
- **Length:** Distance between endpoints of a line segment.
- **Ruler:** Instrument marked with units to measure length.
- **Divider:** Tool with two pointed arms to transfer lengths.

Angles – Right and Straight

An angle is formed when a figure turns from one direction to another around a point. A right angle measures exactly 90°, and a straight angle measures exactly 180°.

Concept Explanation

Facing north, a clockwise turn to east is a right angle (90°). Two right angle turns from north to south make a straight angle (180°). Turning by two straight angles (360°) completes a full revolution.

Worked Illustration

Using a compass rose, turning from north to east is 90°, from north to south is 180°, and a full turn back to north is 360°.

Practice Set

- **Level 1 – Easy:** Identify right angles in your classroom.
- **Level 2 – Moderate:** Use a compass to mark right and straight angles.
- **Level 3 – Challenging:** Calculate the number of right angles in three full revolutions.

Answer Key

- Level 1: Examples include corners of a book, window frames.
- Level 2: Marked angles at 90° and 180° using compass.
- Level 3: Three revolutions = 3 × 360° = 1080°, number of right angles = 1080° ÷ 90° = 12.

Quick Reference

- Right angle = 90°
- Straight angle = 180°
- Full revolution = 360°

Glossary

- **Right Angle:** Angle of 90°.
- **Straight Angle:** Angle of 180°.
- **Revolution:** Complete turn of 360°.

Angles – Acute, Obtuse and Reflex

Angles are classified based on their measure:

- **Acute Angle:** Less than 90°.
- **Obtuse Angle:** Greater than 90° but less than 180°.
- **Reflex Angle:** Greater than 180° but less than 360°.

Concept Explanation

Examples include the angle of a ladder leaning against a wall (acute), the angle of an open book (obtuse), and the larger angle around a clock hand (reflex).

Practice Set

- **Level 1 – Easy:** Identify acute angles in everyday objects.
- **Level 2 – Moderate:** Draw obtuse angles using a protractor.
- **Level 3 – Challenging:** Find reflex angles formed by clock hands at specific times.

Answer Key

- Level 1: Examples include roof slopes, open book angles.
- Level 2: Draw angles between 90° and 180° using protractor.
- Level 3: At 10:10, reflex angle between hour and minute hands is approximately 320°.

Quick Reference

- Acute < 90°
- Obtuse > 90° and < 180°
- Reflex > 180° and < 360°

Glossary

- **Acute Angle:** Angle less than 90°.
- **Obtuse Angle:** Angle between 90° and 180°.
- **Reflex Angle:** Angle between 180° and 360°.

Measuring Angles

Angles are measured in degrees (°). One full revolution is 360°, divided into 360 equal parts called degrees. A protractor is used to measure angles precisely.

Using a Protractor

1. Place the midpoint of the protractor at the vertex of the angle.
2. Align one side of the angle with the zero line of the protractor.
3. Read the degree measure where the other side crosses the protractor scale.

Worked Example

Measure $\angle ABC$:

1. Place the protractor center at point B.
2. Align ray BC with 0° on the protractor.
3. Read the scale where ray BA crosses; suppose it reads 40°.
4. Therefore, $m\angle ABC = 40^\circ$.

Practice Set

- **Level 1 – Easy:** Measure angles of a triangle using a protractor.
- **Level 2 – Moderate:** Draw angles of 30°, 60°, and 120° using a protractor.
- **Level 3 – Challenging:** Measure angles formed by clock hands at 3:15 and 9:45.

Answer Key

- Level 1: Sum of angles in triangle is 180°.
- Level 2: Accurate drawings of specified angles.
- Level 3: At 3:15, angle between hands is 7.5°; at 9:45, angle is 97.5°.

Quick Reference

- Full circle = 360°
- Right angle = 90°
- Straight angle = 180°
- Use protractor for precise measurement

Glossary

- **Degree:** Unit of angle measurement.
- **Protractor:** Tool to measure and draw angles.
- **Vertex:** Common endpoint of two rays forming an angle.

Perpendicular Lines

Two lines are perpendicular if they intersect to form a right angle (90°). If line AB is perpendicular to line CD, we write $AB \perp CD$.

Properties

- Perpendicularity is symmetric: if $AB \perp CD$, then $CD \perp AB$.
- The perpendicular bisector of a line segment divides it into two equal parts at right angles.

Worked Illustration

Line segment AB with midpoint M. Line MN is perpendicular to AB at M, so MN is the perpendicular bisector of AB.

Practice Set

- **Level 1 – Easy:** Identify perpendicular lines in your surroundings.
- **Level 2 – Moderate:** Draw perpendicular bisector of a given line segment.
- **Level 3 – Challenging:** Prove that the diagonals of a rectangle are equal and bisect each other perpendicularly.

Answer Key

- Level 1: Examples include corners of a book, window frames.
- Level 2: Use ruler and set square to draw perpendicular bisector.
- Level 3: Use coordinate geometry or congruent triangles to prove properties.

Quick Reference

- Perpendicular lines meet at 90°
- Perpendicular bisector divides segment equally
- Notation: $AB \perp CD$

Glossary

- **Perpendicular Lines:** Lines intersecting at 90°.
- **Bisector:** A line dividing a segment or angle into two equal parts.

Classification of Triangles

A triangle is a polygon with three sides. Triangles are classified based on their sides and angles.

Classification by Sides

- **Scalene Triangle:** All sides unequal.
- **Isosceles Triangle:** Two sides equal.
- **Equilateral Triangle:** All sides equal.

Classification by Angles

- **Acute Angled Triangle:** All angles less than 90°.
- **Right Angled Triangle:** One angle exactly 90°.

- **Obtuse Angled Triangle:** One angle greater than 90°.

Worked Illustration

Measure sides and angles of given triangles using ruler and protractor to classify them.

Practice Set

- **Level 1 – Easy:** Identify types of triangles from given diagrams.
- **Level 2 – Moderate:** Draw examples of each type of triangle.
- **Level 3 – Challenging:** Prove properties of isosceles triangles using congruence.

Answer Key

- Level 1: Classify based on side and angle measures.
- Level 2: Accurate sketches of each triangle type.
- Level 3: Use triangle congruence criteria (SAS, ASA) for proofs.

Quick Reference

- Sum of interior angles = 180°
- Equilateral: all sides and angles equal (60° each)
- Isosceles: two sides and two angles equal
- Scalene: all sides and angles unequal

Glossary

- **Triangle:** Polygon with three sides.
- **Equilateral:** All sides equal.
- **Isosceles:** Two sides equal.
- **Scalene:** No sides equal.

- **Acute Angle:** < 90°.
- **Right Angle:** = 90°.
- **Obtuse Angle:** > 90°.

Quadrilaterals

A quadrilateral is a polygon with four sides and four angles. Examples include rectangles, squares, parallelograms, rhombuses, and trapeziums.

Properties and Classification

Quadrilateral	Opposite Sides Parallel	Opposite Sides Equal	All Sides Equal	Opposite Angles Equal	Diagonals Equal	Diagonals Perpendicular
Parallelogram	Yes	Yes	No	Yes	No	No
Rectangle	Yes	Yes	No	Yes (90° each)	Yes	No
Square	Yes	Yes	Yes	Yes (90° each)	Yes	Yes
Rhombus	Yes	Yes	Yes	Yes	No	Yes
Trapezium	One pair	No	No	No	No	No

Worked Illustration

Using set squares and rulers to construct and identify properties of rectangles, squares, parallelograms, rhombuses, and trapeziums.

Practice Set

- **Level 1 – Easy:** Identify quadrilaterals in your surroundings.

- **Level 2 – Moderate:** Draw and measure sides and angles of quadrilaterals.
- **Level 3 – Challenging:** Prove properties of diagonals in rhombus and rectangle.

Answer Key

- Level 1: Examples include windows (rectangles), tiles (squares).
- Level 2: Measurements confirm properties like equal sides or right angles.
- Level 3: Use congruence and coordinate geometry for proofs.

Quick Reference

- Rectangle: Opposite sides equal and parallel, all angles 90°
- Square: All sides equal, all angles 90°, diagonals equal and perpendicular
- Rhombus: All sides equal, opposite sides parallel, diagonals perpendicular
- Trapezium: One pair of opposite sides parallel

Glossary

- **Quadrilateral:** Polygon with four sides.
- **Parallelogram:** Both pairs of opposite sides parallel.
- **Rectangle:** Parallelogram with right angles.
- **Square:** Rectangle with all sides equal.
- **Rhombus:** Parallelogram with all sides equal.
- **Trapezium:** Quadrilateral with one pair of parallel sides.

Polygons

A polygon is a closed figure made up of straight line segments. Polygons are named based on the number of sides they have.

Common Polygons

Number of Sides	Name
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
8	Octagon

Worked Illustration

Examples of polygons in real life include windows (rectangles), honeycombs (hexagons), and stop signs (octagons).

Practice Set

- **Level 1 – Easy:** Identify polygons around you and name them.
- **Level 2 – Moderate:** Draw polygons with 3 to 8 sides.
- **Level 3 – Challenging:** Calculate the sum of interior angles of polygons with n sides using formula $(n-2) \times 180^\circ$.

Answer Key

- Level 1: Examples include triangular road signs, rectangular doors.
- Level 2: Accurate drawings of polygons with specified sides.
- Level 3: Sum of interior angles for pentagon (5 sides) = 540°, hexagon (6 sides) = 720°.

Quick Reference

- Polygon: Closed figure with straight sides
- Triangle: 3 sides

- Quadrilateral: 4 sides
- Pentagon: 5 sides
- Hexagon: 6 sides
- Octagon: 8 sides
- Sum of interior angles = $(n-2) \times 180^\circ$

Glossary

- **Polygon:** Closed figure with straight sides.
- **Triangle:** 3-sided polygon.
- **Quadrilateral:** 4-sided polygon.
- **Pentagon:** 5-sided polygon.
- **Hexagon:** 6-sided polygon.
- **Octagon:** 8-sided polygon.