Point

A point is a precise location in space without any length, breadth, or thickness. It is represented by a capital letter and can be visualized as a dot on paper.

Fundamental Facts

- A point determines a specific location.
- Points are denoted by capital letters such as A, B, C.

Worked Illustration

Mark three points on a paper and label them A, B, and C.

Practice Set

- Level 1: Mark and label five points on a sheet of paper.

- Level 2: Identify points on a given geometric figure and name them.
- Level 3: Given a coordinate plane, plot points at specified coordinates.

Answer Key

- Level 1: Points labeled as A, B, C, D, E.
- Level 2: Points named as per figure labels.
- Level 3: Points plotted correctly at given coordinates.

Quick Reference

Point: Location without size, denoted by capital letters.

Glossary

- **Point:** A location in space with no dimensions.

Line Segment

A line segment is the shortest path between two points, having fixed endpoints. It is denoted by $\overline{AB}$ or $\overline{BA}$.

Formula Derivation

The length of a line segment $\overline{AB}$ is the distance between points A and B, calculated using the distance formula if coordinates are given:

$$\text{Length} = \sqrt{(x_B - x_A)^2 + (y_B - y_A)^2}$$

Worked Illustration

Given points A and B, connect them to form $\overline{AB}$. Measure the length using a ruler.

Example

Name any three line segments in the figure with points A, B, C, D, E, G connected.

Solution: $\overline{AB}, \overline{BC}, \overline{CD}$

Practice Set

- Level 1: Identify line segments in a given polygon.
- Level 2: Calculate the length of line segments given coordinates.
- Level 3: Prove that the sum of lengths of two line segments is greater than the third in a triangle.

Answer Key

- Level 1: Line segments named as per polygon sides.
- Level 2: Lengths calculated using distance formula.
- Level 3: Triangle inequality verified stepwise.

Quick Reference

Line segment: Part of a line with two endpoints, fixed length.

Glossary

- **Line Segment:** Shortest path between two points.

Lines

A line is a straight set of points extending infinitely in both directions with no thickness. It is denoted by two points on it or a lowercase letter.

Concept Explanation

Extending a line segment indefinitely on both sides forms a line.

Worked Illustration

Line through points A and B is denoted as $\overleftrightarrow{AB}$ or simply l.

Practice Set

- Level 1: Identify lines in a given figure.
- Level 2: Write equations of lines passing through given points.
- Level 3: Prove properties of lines such as collinearity.

Answer Key

- Level 1: Lines named as per points.
- Level 2: Equations derived using point-slope form.
- Level 3: Proofs provided stepwise.

Quick Reference

Line: Infinite set of points extending both ways.

Glossary

- **Line:** Infinite straight path with no endpoints.

Intersecting Lines

Intersecting lines are two distinct lines that meet at a single point called the point of intersection.

Concept Explanation

Lines l_1 and l_2 intersect at point O if O lies on both lines.

Worked Illustration

Lines l_1 and l_2 intersect at O, forming an "X" shape.

Practice Set

- Level 1: Identify intersecting lines in a figure.
- Level 2: Find coordinates of intersection point given line equations.
- Level 3: Prove that two lines are intersecting using algebraic methods.

Answer Key

- Level 1: Lines identified as intersecting.

- Level 2: Intersection point calculated by solving equations.
- Level 3: Proofs with algebraic steps.

Quick Reference

Intersecting lines: Lines meeting at a point.

Glossary

- **Point of Intersection:** The point where two lines meet.

Parallel Lines

Parallel lines are two lines in a plane that never meet, no matter how far extended. They have the same direction and constant distance apart.

Concept Explanation

Lines l and m are parallel if they do not intersect and the distance between them is constant.

Worked Illustration

Lines $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ are parallel, denoted as $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$.

Practice Set

- Level 1: Identify parallel lines in a figure.

- Level 2: Prove lines are parallel using slope criteria.
- Level 3: Solve problems involving parallel lines and transversals.

Answer Key

- Level 1: Parallel lines named.
- Level 2: Slopes calculated and compared.
- Level 3: Stepwise solutions involving angle properties.

Quick Reference

Parallel lines: Lines that never intersect.

Glossary

- **Parallel Lines:** Lines equidistant and non-intersecting.

Ray

A ray starts at a point and extends infinitely in one direction. It has one endpoint and is denoted as $\overrightarrow{AB}$ starting at A through B.

Concept Explanation

Ray $\overrightarrow{AB}$ begins at point A and passes through B, extending endlessly beyond B.

Worked Illustration

Identify rays such as $\overrightarrow{AB}$, $\overrightarrow{AC}$ in a figure with points A, B, C.

Practice Set

- Level 1: Identify rays in a given figure.
- Level 2: Write notation for rays given points.
- Level 3: Prove properties involving rays and angles.

Answer Key

- Level 1: Rays named correctly.
- Level 2: Notations written as $\overrightarrow{AB}$.
- Level 3: Proofs with stepwise reasoning.

Quick Reference

Ray: Starts at a point, extends infinitely in one direction.

Glossary

- **Ray:** Part of a line with one endpoint and infinite length in one direction.

Angles

An angle is formed by two rays sharing a common endpoint called the vertex. The rays are called the arms of the angle.

Concept Explanation

Angle $\angle AOB$ has vertex O and arms $\overrightarrow{OA}$ and $\overrightarrow{OB}$.

Angle Measurement

Angles are measured in degrees (°) using a protractor.

Procedure to Measure an Angle

1. Place the midpoint of the protractor on the vertex.
2. Align one arm with the zero line of the protractor.
3. Read the degree where the other arm crosses the protractor scale.

Types of Angles

Type	Degree Range
Acute Angle	Less than 90°
Right Angle	Exactly 90°
Obtuse Angle	Between 90° and 180°
Straight Angle	Exactly 180°
Reflex Angle	Between 180° and 360°
Complete Angle	Exactly 360°

Example

Measure $\angle ABC$ using a protractor and find its degree.

Solution: Place the protractor at vertex B, align BC with zero line, read the scale at BA. Suppose it reads 45°, then $\angle ABC = 45^\circ$.

Practice Set

- Level 1: Identify types of angles in given figures.
- Level 2: Measure angles using a protractor.
- Level 3: Solve problems involving angle sums in polygons.

Answer Key

- Level 1: Angles classified correctly.
- Level 2: Angles measured with correct degree values.
- Level 3: Stepwise solutions using angle sum properties.

Quick Reference

Angle: Formed by two rays with a common vertex, measured in degrees.

Glossary

- **Vertex:** Common endpoint of two rays forming an angle.
- **Arms:** The two rays forming the angle.
- **Protractor:** Instrument to measure angles.

Angle Comparison

Angles can be compared by superimposing them with vertices overlapping to determine which is larger or smaller.

Types of Angles and Properties

Angle Type	Degree Range	Property
Acute	< 90°	Smaller than right angle
Right	= 90°	Exactly one quarter turn
Obtuse	90° < angle < 180°	Larger than right angle but less than straight
Straight	= 180°	Forms a straight line
Reflex	180° < angle < 360°	Greater than straight angle
Complete	= 360°	Full rotation

Practice Set

- Level 1: Identify angle types from given measures.
- Level 2: Compare two angles and state which is larger.
- Level 3: Prove angle relationships using comparison and properties.

Answer Key

- Level 1: Correct angle type identification.
- Level 2: Correct comparison with reasoning.
- Level 3: Stepwise proofs using angle properties.

Quick Reference

Angle comparison: Superimpose angles to compare sizes.

Glossary

- **Superimposition:** Placing one angle over another to compare.