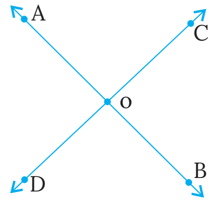
Intersecting and Parallel Lines

i. Definition and Explanation

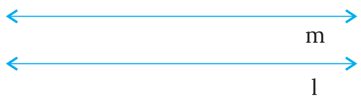
What is a Line? A line is a straight path of points that extends infinitely in both directions. It has no thickness and no endpoints. We represent it with arrows at both ends.

Intersecting Lines: - When two or more lines cross each other at a single, common point, they are called intersecting lines.



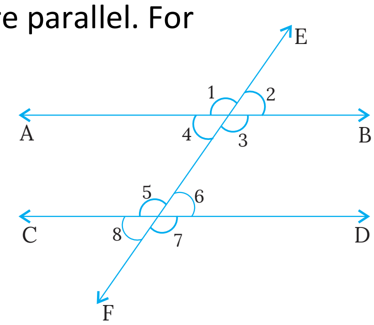
- **Explanation:** Imagine two straight roads crossing each other at an intersection. That crossing point is the point of intersection. At this point, four angles are formed.
- **Special Case:** When two lines intersect and form a right angle (90°), they are called perpendicular lines.

Parallel Lines: - Two lines in the same plane that never intersect, no matter how far they are extended, are called parallel lines.



- **Explanation:** Think of the two rails of a straight train track. They are always the same distance apart and will never meet. The distance between them is constant.
- **Notation:** We use the symbol || to show that lines are parallel. For example, line l || line m.

Transversal Line: - A transversal is a line that intersects two or more other lines at distinct (different) points.



- **Explanation:** When a transversal cuts across two lines, it creates eight angles. Understanding the relationships between these angles is the key to this topic.

ii. Key Points and Important Terms

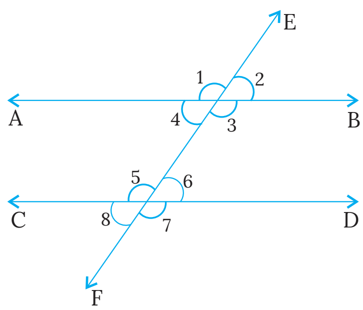
When a transversal intersects two lines, the following angles are formed:

Interior Angles: Angles that lie between the two lines.

- **Example:** Angles 3, 4, 5, 6.

Exterior Angles: Angles that lie outside the two lines.

- **Example:** Angles 1, 2, 7, 8.



Angle Pairs Formed by a Transversal

Vertically Opposite Angles: Angles that are opposite each other when two lines intersect. They are always equal.

- **Pairs:** (∠1 & ∠4), (∠2 & ∠3), (∠5 & ∠8), (∠6 & ∠7).

Linear Pair of Angles: Two adjacent angles that form a straight line. They are supplementary (add up to 180°).

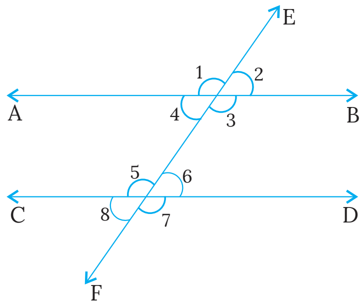
- **Pairs:** (∠1 & ∠2), (∠3 & ∠4), (∠5 & ∠6), (∠7 & ∠8), etc.

Corresponding Angles: Angles that are in the same relative position at each intersection. If the lines are parallel, they are equal.

- **Pairs:** (∠1 & ∠5), (∠2 & ∠6), (∠3 & ∠7), (∠4 & ∠8).

Alternate Interior Angles: A pair of interior angles on opposite sides of the transversal. If the lines are parallel, they are equal.

- **Pairs:** (∠3 & ∠6), (∠4 & ∠5).



Alternate Exterior Angles: A pair of exterior angles on opposite sides of the transversal. If the lines are parallel, they are equal.

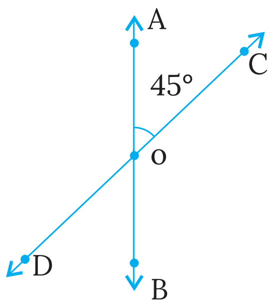
- **Pairs:** (∠1 & ∠8), (∠2 & ∠7).

Consecutive Interior Angles (or Co-interior Angles): A pair of interior angles on the same side of the transversal. If the lines are parallel, they are supplementary (add up to 180°).

- **Pairs:** (∠3 & ∠5), (∠4 & ∠6).

iii. Detailed Examples with Solutions

Example 1: Basic Intersecting Lines Two lines, AB and CD, intersect at point O. If ∠AOC = 45°, find the measure of all other angles.



Solution:

Given: ∠AOC = 45°.

Vertically Opposite Angle: ∠BOD is vertically opposite to ∠AOC. Therefore,
∠BOD = ∠AOC = 45°.

Linear Pair: ∠AOC and ∠AOD form a linear pair. So,
∠AOC + ∠AOD = 180°. 45° + ∠AOD = 180° ∠AOD = 180° - 45° = 135°.

Vertically Opposite Angle: ∠BOC is vertically opposite to ∠AOD. Therefore, ∠BOC = ∠AOD = 135°.

Answer: ∠BOD = 45°, ∠AOD = 135°, ∠BOC = 135°.

iv. Summary of Main Concepts

- **Intersecting Lines:** Two lines that cross at one point.
- **Parallel Lines:** Two lines that are in the same plane and never cross. The distance between them is constant.
- **Transversal:** A line that intersects two or more other lines.
- **The Golden Rule:** The special angle relationships only apply when the lines are parallel.
- **EQUAL Angles:**
    - Corresponding Angles
    - Alternate Interior Angles
    - Alternate Exterior Angles
    - Vertically Opposite Angles (always equal)
- **SUPPLEMENTARY Angles (add to 180°):**
    - Consecutive Interior Angles
    - Linear Pair (always supplementary)
- **Converse Rule:** If any of the parallel line angle relationships (e.g., corresponding angles are equal) are true, then you can conclude that the lines must be parallel.