

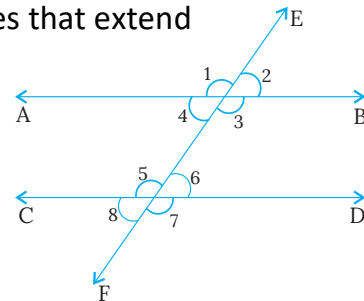
## Transversals and Angles Formed

### i. Definition and Explanation

#### What are Lines and Transversals?

**Lines:** In this context, we are talking about straight lines that extend infinitely in both directions.

**Parallel Lines:** Two or more lines on a plane that are always the same distance apart and will never intersect. We use small arrows on the lines to show they are parallel.



**Transversal:** A line that intersects (crosses) two or more other lines at distinct (different) points.

Think of it like this: Imagine two parallel roads (Lines A and B). A third road (the Transversal) is built to cross both of them. This transversal creates intersections and a set of new angles.

When a transversal cuts across two lines, it forms eight angles. Our goal is to understand the names of these angles and the special relationships they have, especially when the two lines are parallel.

### ii. Key Points and Important Terms

Let's use a standard diagram to name the angles formed.

#### Angle Classification by Position:

**Interior Angles:** Angles that lie between the two lines (m and n).

In our diagram:  $\angle 3$ ,  $\angle 4$ ,  $\angle 5$ ,  $\angle 6$

**Exterior Angles:** Angles that lie outside the two lines (m and n).

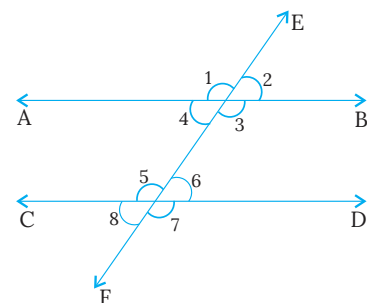
In our diagram:  $\angle 1$ ,  $\angle 2$ ,  $\angle 7$ ,  $\angle 8$

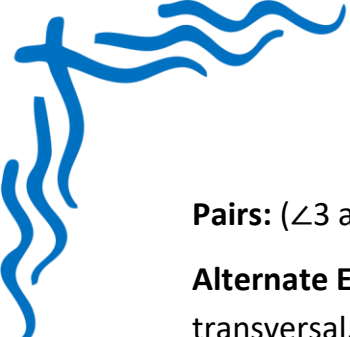
#### Special Angle Pairs:

**Corresponding Angles:** Angles that are in the same relative position at each intersection. Think of them as being in the "same corner".

**Pairs:** ( $\angle 1$  and  $\angle 5$ ), ( $\angle 2$  and  $\angle 6$ ), ( $\angle 3$  and  $\angle 7$ ), ( $\angle 4$  and  $\angle 8$ )

**Alternate Interior Angles:** A pair of interior angles on opposite sides of the transversal.





**Pairs:** ( $\angle 3$  and  $\angle 6$ ), ( $\angle 4$  and  $\angle 5$ )

**Alternate Exterior Angles:** A pair of exterior angles on opposite sides of the transversal.

**Pairs:** ( $\angle 1$  and  $\angle 8$ ), ( $\angle 2$  and  $\angle 7$ )

**Consecutive Interior Angles (or Same-Side Interior Angles):** A pair of interior angles on the same side of the transversal.

**Pairs:** ( $\angle 3$  and  $\angle 5$ ), ( $\angle 4$  and  $\angle 6$ )

**Vertically Opposite Angles:** Angles opposite each other when two lines cross. They are always equal.

**Pairs:** ( $\angle 1$  and  $\angle 4$ ), ( $\angle 2$  and  $\angle 3$ ), ( $\angle 5$  and  $\angle 8$ ), ( $\angle 6$  and  $\angle 7$ )

**Linear Pair of Angles:** Two adjacent angles that form a straight line. They are always supplementary (add up to  $180^\circ$ ).

**Examples:** ( $\angle 1$  and  $\angle 2$ ), ( $\angle 3$  and  $\angle 4$ ), ( $\angle 1$  and  $\angle 3$ ), etc.

### iii. Detailed Examples with Solutions

#### Example 1: Finding all angles

In the diagram below, line  $a$  is parallel to line  $b$ . If  $m\angle 1 = 120^\circ$ , find the measure of all other angles.

**Solution:**

$$m\angle 1 = 120^\circ \text{ (Given)}$$

$$m\angle 4 = 120^\circ \text{ (Vertically opposite to } \angle 1)$$

$$m\angle 2 = 180^\circ - 120^\circ = 60^\circ \text{ (Linear pair with } \angle 1)$$

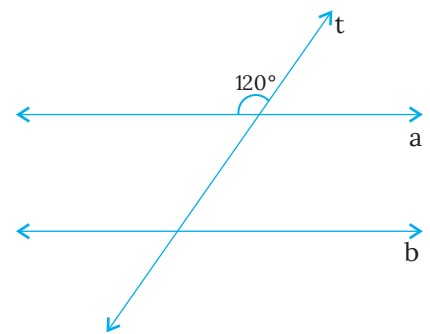
$$m\angle 3 = 60^\circ \text{ (Vertically opposite to } \angle 2)$$

$$m\angle 5 = 120^\circ \text{ (Corresponding to } \angle 1, \text{ and lines are parallel)}$$

$$m\angle 8 = 120^\circ \text{ (Vertically opposite to } \angle 5)$$

$$m\angle 6 = 60^\circ \text{ (Corresponding to } \angle 2, \text{ and lines are parallel)}$$

$$m\angle 7 = 60^\circ \text{ (Vertically opposite to } \angle 6)$$



#### Example 2: Using Algebra

Lines  $m$  and  $n$  are parallel. Find the value of  $x$ .

### Solution:

Identify the relationship: The angle labeled  $(2x + 10)^\circ$  and the angle labeled  $70^\circ$  are Alternate Interior Angles.

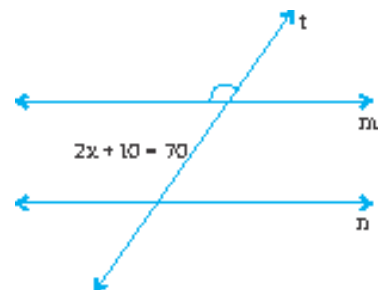
Apply the rule: Since lines  $m$  and  $n$  are parallel, alternate interior angles are equal.

Set up the equation:  $2x + 10 = 70$

Solve for  $x$ :

Subtract 10 from both sides:  $2x = 60$

Divide by 2:  $x = 30$



### iv. Summary of Main Concepts

- A transversal is a line that crosses at least two other lines.
- When a transversal crosses two lines, it forms 8 angles, which can be classified as interior or exterior.
- **Key angle pairs are:** Corresponding, Alternate Interior, Alternate Exterior, and Consecutive Interior.
- **THE GOLDEN RULE:** If the transversal crosses PARALLEL lines:
  - Corresponding, Alternate Interior, and Alternate Exterior angles are EQUAL.
  - Consecutive Interior angles are SUPPLEMENTARY (add to  $180^\circ$ ).
- **Converse is also true:** If any of these angle pair relationships are true (e.g., if corresponding angles are equal), then the lines must be parallel.