CHAPTER 6
LINES AND ANGLES

➢ Some Definitions

- **Point:** It has neither length nor breadth, nor thickness, however, it has a unique position.
- **Line:** A line has neither breadth nor thickness, however it has a sense of length.
- **Plane:** A plane has sense of length and breadth but not of thickness.
- **Line Segment:** A finite portion of a line is called a line segment. A line segment has two end points.
- **Ray:** A portion of a line extended in one direction from a fixed point is called a ray. The fixed point is called the initial point (end point) of the ray.

Note:

(i) A line segment is a part of a line with two end points.

(ii) A ray is a part of a line with one end point.

- **Collinear Points:** Three or more points are said to be collinear if there is a line which contains all of them.
- **Concurrent Lines:** Three or more lines are said to be concurrent if there is a point which lies on all of them.
- **Angle:** An angle is formed by two rays with a common initial point. The common initial point is called the vertex of the angle. The rays forming an angle are called arms or sides of the angle.

➢ Types of Angles:

(i) Acute angle: An angle whose measure lies between 0^0 and 90^0 is called an acute angle.

(ii) Right angle: An angle whose measure is 90^0 is called a right angle.

(iii) Obtuse angle: An angle whose measure is greater than 90^0 but less than 180^0 is called an obtuse angle.

(iv) Straight angle: An angle whose measure is 180^0 is called a straight angle.

(v) Reflex angle: An angle whose measure is greater than 180^0 but less than 360^0 is called a reflex angle.

(vi) Complete angle: An angle whose measure is 360^0 is called a complete angle.

➢ **Complementary Angles:** Two angles, the sum of whose measure is 90^0, are called complementary angles. Each of the two complementary angles is called the complement of the other.

➢ **Supplementary Angles:** Two angles, the sum of whose measure is 180^0, are called supplementary angles. Each of the two supplementary angles is called the supplement of the other.

- **Adjacent Angles:** Two angles are called adjacent angles if
  (i) they have the same vertex
  (ii) they have a common arm and
  (iii) do not overlap
- **Linear Pair Angles:** Two adjacent angles are said to form a linear pair angles, if their non-common arms are two opposite rays.

Theorem 6.1: If a ray stands on a line, then the sum of the two adjacent angles so formed is 180^0.

Theorem 6.2: If the sum of two adjacent angles is 180^0, then their non-common arms are two opposite rays.

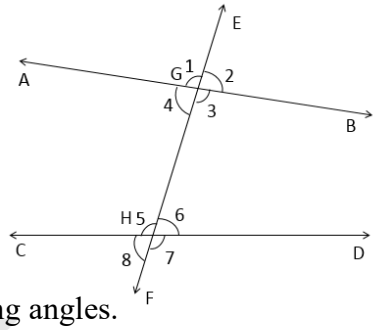
- **Vertically opposite angles**

Two angles are said to be vertically opposite angles, if their arm form two pairs of opposite rays.

Theorem 6.3: If two lines intersect, the vertically opposite angles are equal in measure.

- **Angles made by a transversal with two lines:**

A transversal $\overleftrightarrow{EF}$ intersects two lines AB and CD at G and H.



From the above figure,

$(\angle 1, \angle 5)$, $(\angle 2, \angle 6)$, $(\angle 3, \angle 7)$, $(\angle 4, \angle 8)$ are called pairs of corresponding angles.

$(\angle 3, \angle 5)$, $(\angle 4, \angle 6)$ are called pairs of alternate interior angles or simply alternate angles.

$(\angle 3, \angle 6)$, $(\angle 4, \angle 5)$ are called pairs of interior angles on the same side of the transversal.

- **Axiom 6.4**: If a transversal intersects two parallel lines, then the angles in each pair of corresponding angles are equal.
- **Axiom 6.5**: If a transversal intersects two lines making a pair of corresponding angles equal, then the lines are parallel.
- **Theorem 6.6:** If a transversal intersects two parallel lines, then alternate angles are equal.
- **Theorem 6.7:** If a transversal intersects two lines in such a way that, a pair of alternate angles are equal, then the two lines are parallel.
- **Theorem 6.8:** If a transversal intersects two parallel lines, then the interior angles on the same side of the transversal are supplementary.

- **Theorem 6.9:** If a transversal intersects two lines in such a way that a pair of interior angles on the same side of the transversal are supplementary, then the two lines are parallel.
- **Theorem 6.10:** Two lines which are parallel to the same line are parallel to one another.

Triangle and its Angles

- **Theorem 6.11 (Angle Sum Property of Triangle):** The sum of the measures of three angles of a triangle is 180^0.

Exterior angles of a triangle:

- **Theorem 6.12:** If a side of a triangle is produced, then the exterior angle so formed is equal to the sum of the two interior opposite angles.

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