LINES & ANGLES

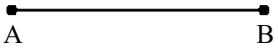
DEFINITIONS

◈ **Point**

A fine dot made by a sharp pencil or a geometrical figure having no length, breadth and height is called a point.

◈ **Line Segment**

A geometrical figure obtained by joining two points is called a line segment.



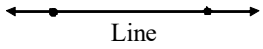
Here AB is a line segment.

It has definite length.

◈ **Line**

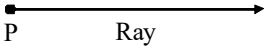
If we extend the two end points in either direction endlessly, we get a line.

It has no definite length.



◈ **Ray**

A ray is a geometrical figure which has one end point. P is an end point.



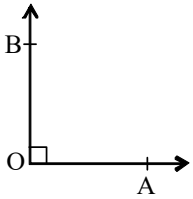
◈ **Angles**

An angle is formed when two rays/two lines/two line segments initiate from the same initial point.

We find many examples of angles in our surroundings like between two walls of a room, between edges of a table, road crossing, etc.

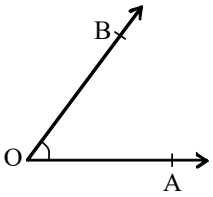
◈ **Right angle**

An angle of measure 90° is called a right angle. In figure ∠BOA is a right angle.



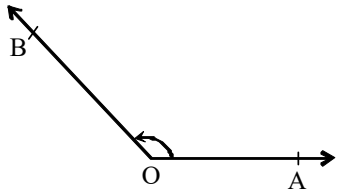
◈ **Acute angle**

An angle whose measure is between 0° and 90° is called an acute angle.



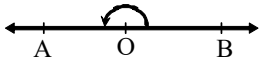
◈ **Obtuse angle**

An angle whose measure is more than 90° but less than 180° is called an obtuse angle.



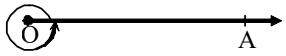
◈ **Straight angle**

An angle of 180° is called a straight angle.



◈ **Complete angle**

An angle of 360° is called a complete angle.



◈ **Complementary Angles**

Two angles are said to be complementary if the sum of their measures is 90°, and each angle is said to be complement of each other.

For example, (45°, 45°), (10°, 80°), (20°, 70°), (30°, 60°).

Note :

(a) If two angles are complement of each other then each angle is an acute angle, but any two acute angles need not be complementary, for example, 20° and 60° are acute angles but are not complement of each other.

(b) Two obtuse angles and two right angles cannot be complement of each other.

◈ **Supplementary Angles**

Two angles are said to be supplementary if sum of their measures is 180°, and each angle is said to be supplement of each other.

For example, (10°, 170°), (20°, 160°), (30°, 150°), (40°, 140°), (50°, 130°) etc. are all pairs of supplementary angles.

Note :

(a) Two acute angles cannot be supplement of each other.

(b) Two right angles are always supplementary.

(c) Two obtuse angles cannot be supplement of each other.

◈ **Adjacent Angles**

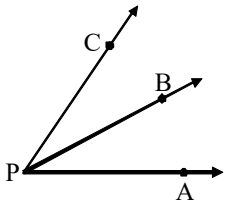
Two angles are called adjacent angles if

(i) they have a common vertex (in figure, point P is common vertex).

(ii) they have a common arm (in figure, PB is common arm).

(iii) their other arms lie on the opposite sides of the common arm (in figure, PC and PA)

So, in figure, $\angle APB$ and $\angle BPC$ are adjacent angles.



Note :

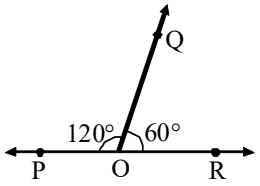
(a) ∠APB and ∠APC are not adjacent angles because their other arms PB and PC are not on the opposite sides of the common arm PA.

(b) If a ray stands on a line then the sum of the adjacent angles so formed is 180°.

◈ **Linear Pair Angles**

Two adjacent angles are said to form a linear pair if their non-common arms are two opposite rays.

In figure, ∠POQ and ∠QOR form a linear pair as their non-common arms OP and OR are two opposite rays i.e., POR is a line.



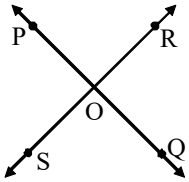
Note :

(a) Two linear pair angles can also be adjacent angles but it is not necessary that two adjacent angles will be linear pair angles.

(b) A pair of supplementary angles forms a linear pair when placed adjacent to each other.

◈ **Vertically Opposite Angles**

Two angles formed by two intersecting lines having no common arm are called vertically opposite angles.



In figure, two lines PQ and RS are intersecting at point O. We observe that with the intersection of these lines, four angles have been formed.

∠POR and ∠SOQ form a pair of vertically opposite angles, while ∠POS and ∠ROQ form another pair of vertically opposite angles.

Note :

Vertically opposite angles are always equal.

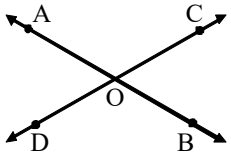
Important Facts :

(1) The sum of all angles formed on the same side of a line at a given point on a line is 180°.

(2) The sum of all angles around a point is 360°.

INTERSECTING LINES

Two lines are said to be intersecting if they have a point in common. This common point is called the point of intersection of intersecting lines.



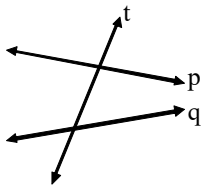
In figure, AB and CD are intersecting lines and O is intersecting point.

For example, letter X made up of line segments contains intersecting lines.

TRANSVERSAL LINE

A line that intersects two or more lines at distinct points is called a transversal line.

In figure, t is a transversal to lines p and q.



PARALLEL LINES

Two lines *l* and *m* are said to be parallel if (i) they lie in the same plane (ii) they do not intersect when produced indefinitely in either direction and we write *l* || *m* (which is read as '*l* is parallel to *m*')

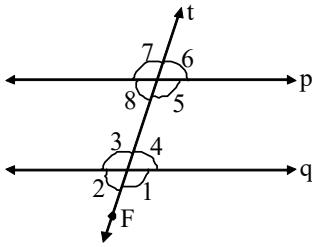
l || *m* also implies that *m* || *l*.

The distance between two parallel lines is same everywhere or if the perpendicular distances between two lines are equal, lines are parallel, other wise not.

For example, the distance between two Railway lines.

Angles formed when a transversal cuts two lines :

Let two lines p and q be cut by a transversal t, then the following angles are formed.



◈ **Exterior Angles**

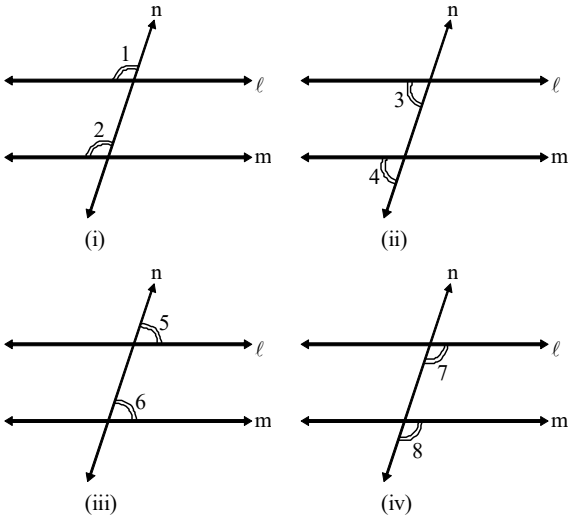
Angles which do not contain the segment of the transversal between the two lines are called exterior angles.

◈ **Interior Angles**

The angles whose arms include the line segment of the transversal between the two lines are called interior angles.

◈ **Corresponding Angles**

Observe the angles marked in each of the figure.



The angles which

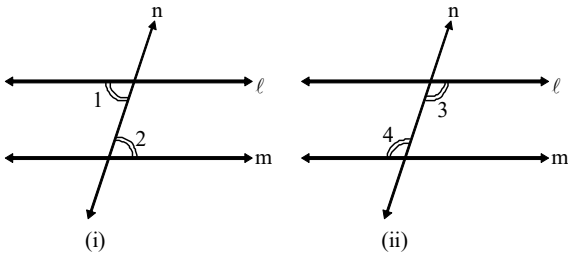
(i) have different vertices

(ii) lie on the same side of the transversal and

(iii) are in corresponding positions (above or below, left or right) relative to the two lines are called corresponding angles.

In other words, two angles on the same side of the transversal either above or below the two given lines are called corresponding angles.

◈ **Alternate Interior Angles**



Alternate interior angles :

(i) have different vertices,

(ii) lie on opposite side of the transversal, and

(iii) lie between the two lines.

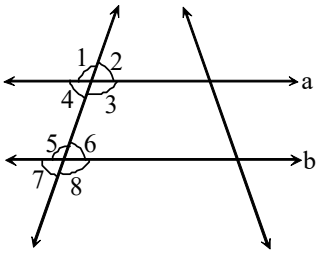
In other words, A pair of angles in which one arm of each of the angle lies on opposite side of the transversal and other arm of the angle is the segment of the transversal, made by the two line is called a pair of alternate interior angles.

Ex. State the property that is used in each of the following statements :

(i) If a || b, then $\angle 1 = \angle 5$

(ii) If $\angle 4 = \angle 6$, then a || b

(iii) If $\angle 4 + \angle 5 = 180°$, then a || b



Sol. (i) If a || b, then $\angle 1 = \angle 5$.

(if lines are parallel then corresponding angles are equal or corresponding angle property)

(ii) If $\angle 4 = \angle 6$, then a || b (if alternate interior angles are equal the lines are parallel or alternate interior angle property)

(iii) If $\angle 4 + \angle 5 = 180°$, then a || b

[as interior angles on the same side (co-interior angles) of the transversal are supplementary].

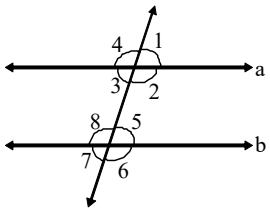
Ex. In the adjoining figure, identify

(i) the pairs of corresponding angles

(ii) the pairs of alternate interior angles

(iii) the pairs of interior angles on the same side of the transversal

(iv) the vertically opposite angles



Sol. (i) The pairs of corresponding angles are :
($\angle$1, $\angle$5), ($\angle$2, $\angle$6), ($\angle$4, $\angle$8) and ($\angle$3, $\angle$7).

(ii) The pairs of alternate interior angles are :
($\angle$2, $\angle$8) and ($\angle$3, $\angle$5).

(iii) The pairs of interior angles on the same side of the transversal are ($\angle$3, $\angle$8) and ($\angle$2, $\angle$5).

(iv) The pairs of vertically opposite angles are ($\angle$1, $\angle$3), ($\angle$4, $\angle$2), ($\angle$5, $\angle$7) and ($\angle$6, $\angle$8).