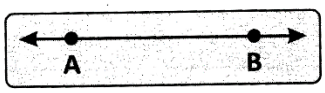
# Lines and Angles

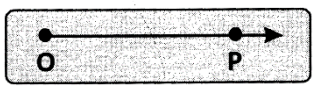
- **Point:** A point is a geometrical representation of a location. It is represented by a dot.

- **Line:** A geometrical line is a set of points that extends endlessly in both the directions i.e., a line has no end points. A line AB is represented as. $\overleftrightarrow{AB}$




- **Line segment:** A line segment is a part of a line. A line segment has two end points. A line segment AB is represented as $\overline{AB}$.


- **Ray:** A ray is a part of the line which has one end point (namely its starting point).

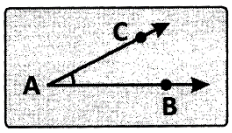



A ray OP is denoted as $\overrightarrow{OP}$.

- **Angle:** An angle is the union of two rays with a common initial point.

The symbol of angle is $\angle$. An angle is measured in degrees $(^\circ)$.

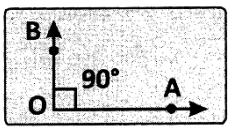
The angle formed by the two rays $\overrightarrow{AB}$ and $\overrightarrow{AC}$ is denoted by $\angle$BAC or $\angle$CAB



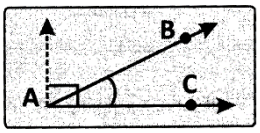

- The two rays $\overrightarrow{AB}$ and $\overrightarrow{AC}$ are called the arms and the common initial point 'A' is called the vertex of the angle ABC.

- **Types of Angles:**

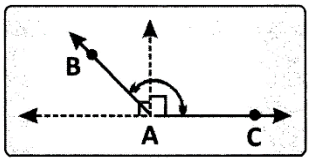
**(i) Right angle:** An angle whose measure is equal to $90^\circ$ is called a right angle.



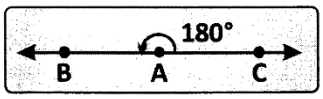

**(ii) Acute angle:** An angle whose measure is less than 90° is called an acute angle.



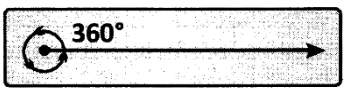

**(iii) Obtuse angle:** An angle whose measure is greater than 90° but less than 180° is called an obtuse angle.



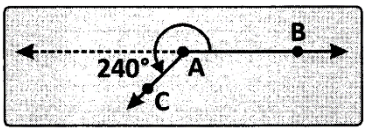

**(iv) Straight angle:** An angle whose measure is equal to 180° is called a straight angle.



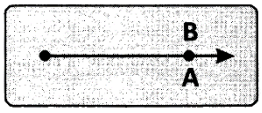

**(v) Complete angle:** An angle whose measure is exactly equal to 360° is called a complete angle.




- **Reflex angle:** An angle which is greater than 180° but less than 360° is called a reflex angle.

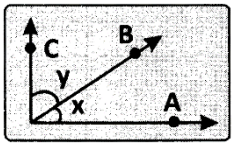



- **Zero angle:** An angle whose measure is 0° is called a zero angle.



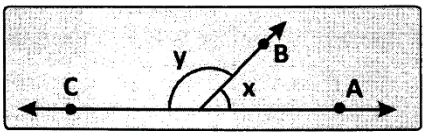

**Related Angles:**

**(i) Complementary angles:** Two angles are said to be complementary if the sum of their measures is equal to 90° .



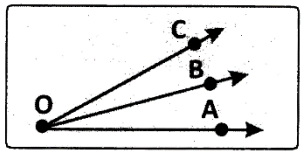

Here $\angle x + \angle y = 90°$, therefore $\angle x$ and $\angle y$ are complementary angles.

**(iii) Supplementary angles:** Two angles are said to be supplementary if the sum of their measures is equal to 180° .



Here, $\angle x + \angle y = 180°$, therefore $\angle x$ and $\angle y$ are supplementary angles.

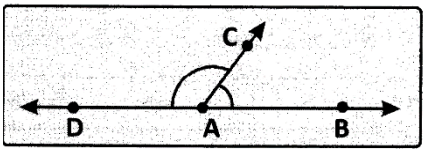
- **Adjacent angles:** Angles having a common vertex, a common arm and the non-common arms lying on either side of the common arm are called adjacent angles.




- In the given figure, $\angle AOB$ and $\angle COB$ have a common vertex'0', a common arm $\overrightarrow{OB}$ *and* $\overrightarrow{OA}$ *and* $\overrightarrow{OC}$ are on opposite sides of $\overrightarrow{OB}$. So they are adjacent angles.

- **Linear pair of angles:** Two adjacent angles make a linear pair of angles, if the non-common arms of these angles form two opposite rays (with same end point).

  In the figure given, the angles BAC and CAD form a linear pair of angles because the non - common arms AB and AD of the two angles are the opposite rays, with the same vertex A.



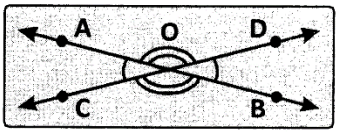

Moreover, $\angle BAC + \angle DAC = 180^{o}$ .

**Note: 1. A liner pair is always supplementary.**

**2. A liner pair is always adjacent need not be a linear pair.**

- **Vertically opposite angles:** Two angles having the same vertex are said to form a pair of vertically opposite angles, if their arms form two pairs of opposite rays.

  In the figure given, $\angle BOD$ and $\angle AOC$ are a pair of vertically opposite angles because they have common vertex at 0 and also OB, OA; OC, OD are two pairs of opposite rays. Vertically opposite angles are formed when two lines intersect.




Similarly, we find that $\angle BOC$ and $\angle AOD$ is

Lines:

**Note: If two lines intersect each other, the vertically opposite angles formed are equal.**

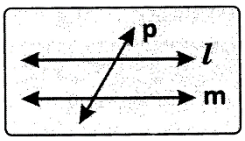
**Pair of lines:**

- **Intersecting lines:** Two lines which are distinct and have a common point are called intersecting lines. The common point is called the point of intersection of the two lines.

- **Perpendicular lines:** If two lines $l$ and m intersect at right angles, they are called perpendicular lines, denoted as $l \perp$ m, read as $l$ is perpendicular to m.

- **Parallel lines:** Two lines $l$ and m are said to be parallel, if they lie in the same plane and do not intersect when produced however far on either side and is written as $l \parallel$ m read as $l$ is parallel to m.

- **Transversal:** A line which intersects two or more lines at distinct points is called a transversal.




In the given figure, p is a transversal to the lines I and m.

- **Angles made by a transversal:**

In the figure given, lines I and m are cut by the transversal p. The eight angles marked 1 to 8 have names given in the table.

| | |
|---|---|
| **Interior angles** | **$\angle 3, \angle 4, \angle 5, \angle 6$** |
| **Exterior angles** | **$\angle 1, \angle 2, \angle 7, \angle 8$** |
| **Pairs of Corresponding angles** | **$\angle 1$ and $\angle 5, \angle 2$ and $\angle 6, \angle 4$ and $\angle 8, \angle 3, \angle 6$** |
| **Pairs of alternate exterior angles** | **$\angle 1$ and $\angle 7, \angle 2$ and $\angle 8$** |
| **Pairs of interior angles on the same side of the transversal** | **$\angle 4$ and $\angle 5, \angle 3$, and $\angle 5$** |

(i) If two parallel lines are cut by a transversal, then

(ii) Each pair of corresponding angles is equal.

(iii) Each pair of alternate interior angles is equal.

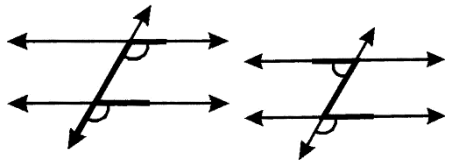
(iv) Each pair of interior angles on the same side of the transversal is supplementary.

(v) Each pair of alternate exterior angles is equal.

(vi) Each pair of exterior angles on the same side of the transversal is supplementary

**Note: (i) The F-Shape stands for fcorrespoding angles.**

**(ii) The Z- Shape for alternate angels.**



- Two lines are said to be parallel, when a transversal cuts these lines such that pairs of

(i) Corresponding angles are equal.

(ii) Alternate interior angles are equal.

(iii) Interior angles on the same side of the transversal are supplementary.