9th Standard-Maths

Lines and Angles

1. Basic Terms and Definitions

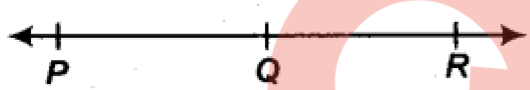
(i) Line segment: A part of a line with two endpoints is called a line segment.

Line segment AB is denoted by $\overline{AB}$.

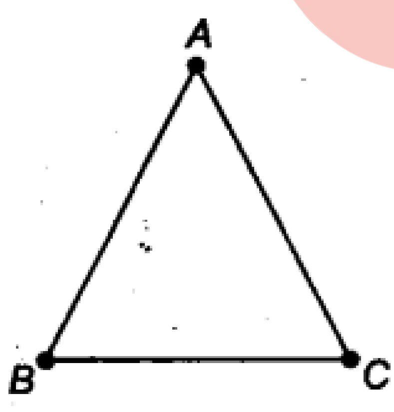
(ii) Ray: A part of a line with one endpoint is called a ray.

The ray AB is denoted

(iii) Collinear points and non-collinear points: If three or more than three points he on the same line, then they are called collinear points, otherwise, they are non-collinear points.

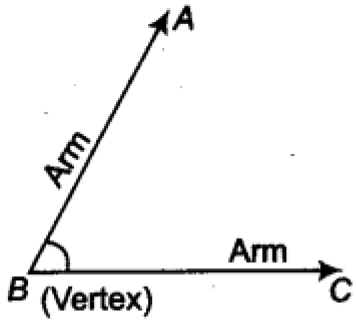


P, Q and R are collinear points.



A, B and C are non-collinear points.

2. **Angle:** An angle is formed when two rays originate from the same endpoint.



Angle ABC is denoted by ∠ABC

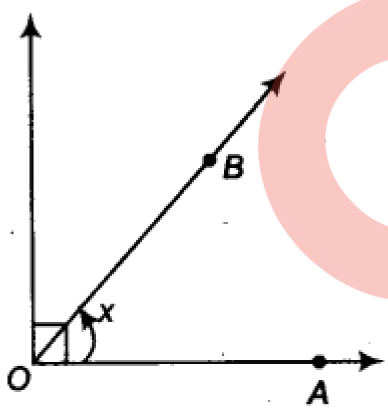
The rays making an angle are called the arms of ∠ABC.

The end point (B) is called the vertex of ∠ABC.

3. **Types of Angles:** There are different types of angles such as acute angle, right angle, obtuse angle, straight angle and reflex angle.

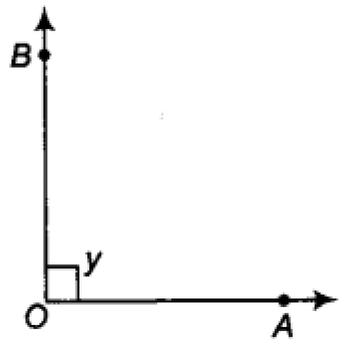
(i) **Acute angle:** An acute angle is an angle which is less than 90°.

Acute angle : $0° < x < 90°$.



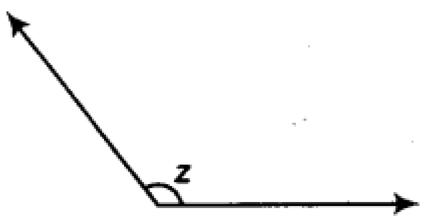
(ii) **Right angle:** A right angle is an angle which is equal to 90°.

Right angle : $y = 90°$



(iii) **Obtuse angle:** An obtuse angle is an angle which is more than 90° and less than 180°.

Obtuse angle : 90° < z < 180°

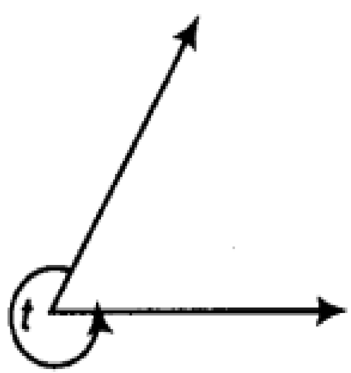


(iv) **Straight angle:** A straight angle is an angle which is equal to 180°.

Straight angle : s = 180°

(v) **Reflex angle:** A reflex angle is an angle, which is more than 180° and less than 360°.

Reflex angle : 180° < t < 360°

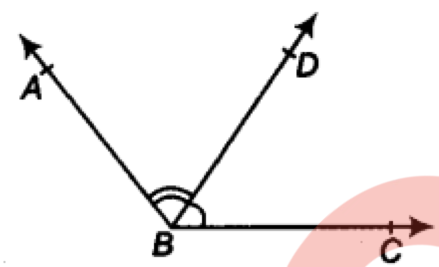


4. **Complementary Angles:** Two angles whose sum is 90° are called complementary angles.

5. **Supplementary Angles:** Two angles whose sum is 180° are called supplementary angles.

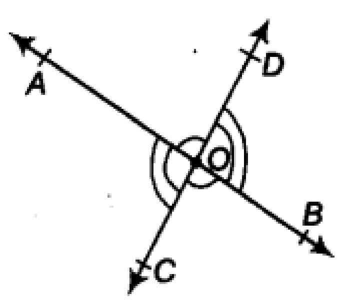
6. **Adjacent Angles:** Two angles are adjacent if they have a common vertex, a common arm and their non-common arms are on different sides of the common arm.

∠ABD and ∠DBC are the adjacent angles. Ray BD is their common arm and point B is their common vertex. Ray BA and ray BC are non-common arms.



Note: ∠ABC = ∠ABD + ∠DBC

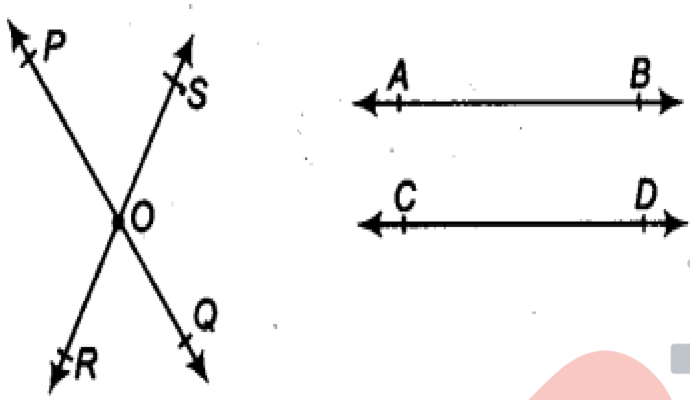
7. **Vertically Opposite Angles:** The vertically opposite angles formed when two lines intersect each other at a point.



Two lines ABand CD intersect each other at point O, then, there are two pairs of vertically opposite angles.

One pair is ∠AOD and ∠BOC and another pair is ∠AOC and ∠BOD.

8. **Intersecting Lines and Non-intersecting Lines**



Lines PQ and RS are intersecting lines because they are intersecting each other at O.

Lines AB and CD are non-intersecting (parallel) lines.

Note: The lengths of the common perpendicular at different points on these parallel lines is the same. This equal length is called the distance between two parallel lines.

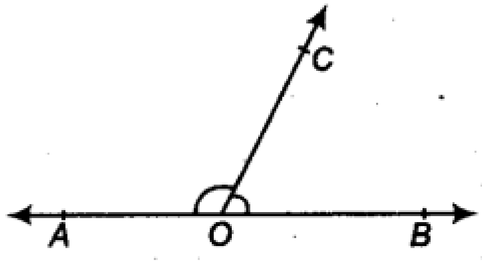
9. **Pairs of Angles**

Linear Pair of Angles: When the sum of two adjacent angles is 180°, then they are called a linear pair of angles.

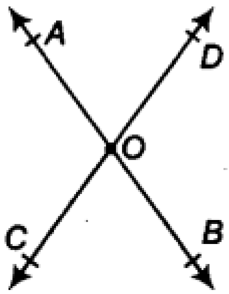
(i) If a ray stands on a line, then the sum of two adjacent angles so formed is 180°.

(ii) If the sum of two adjacent angles is 180°, then a ray stands on a line (that is the non-common arms form a line).

∠AOC + ∠BOC = 180°



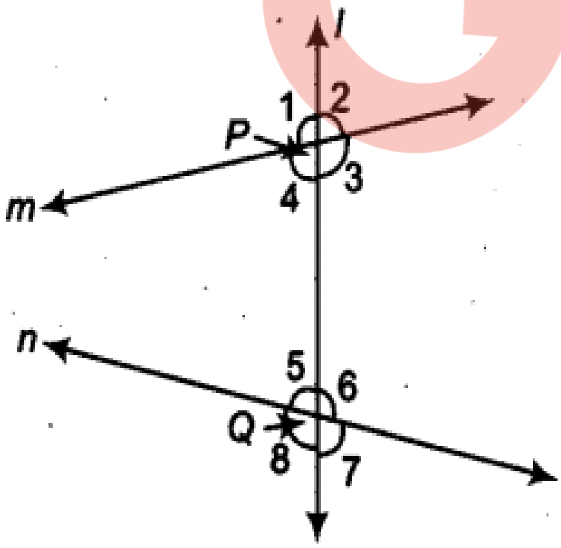
Property: If two lines intersect each other, then the vertically opposite angles are equal.



∠AOD = ∠BOC

∠COA = ∠DOB

10. **Parallel Lines and a Transversal:** A line which intersects two or more lines at distinct points is called a transversal.



Here, line l is a transversal of the lines m and n, respectively.

Line l intersects m and n at P and Q respectively, then four angles are formed at each of the points P and Q namely

$\angle 1, \angle 2, \angle 3, \ldots, \angle 8$

$\angle 1, \angle 2, \angle 7$ and $\angle 8$ are called exterior angles.

$\angle 3, \angle 4, \angle 5$ and $\angle 6$ are called interior angles.

We classify these eight angles in the following groups

(i) Corresponding angles.

- $\angle 1$ and $\angle 5$
- $\angle 2$ and $\angle 6$
- $\angle 4$ and $\angle 8$
- $\angle 3$ and $\angle 7$

(ii) Alternate interior angles

- $\angle 4$ and $\angle 6$
- $\angle 3$ and $\angle 5$

(iii) Alternate exterior angles

- $\angle 1$ and $\angle 7$
- $\angle 2$ and $\angle 8$

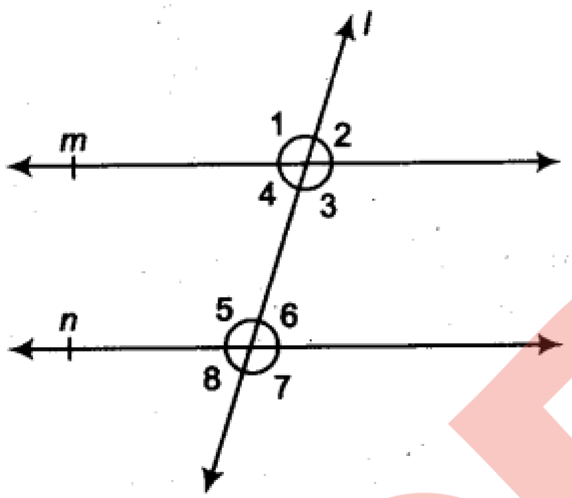
(iv) Interior angles on the same side of the transversal

- $\angle 4$ and $\angle 5$
- $\angle 3$ and $\angle 6$

Note: Interior angles on the same side of the transversal are also referred to as consecutive interior angles or allied angles or co-interior angles.

11. Relation Between the Angles when Line m is Parallel to Line n

(i) If a transversal intersects two parallel lines, then each pair of corresponding angles is equal.



i.e., ∠1 = ∠5, ∠2 = ∠6

and ∠4 = ∠8, ∠3 = ∠7

(ii) If a transversal intersects two lines such that a pair of corresponding angles is equal, then the two lines are parallel to each other.

(iii) If a transversal intersects two parallel lines, then each pair of alternate interior angles is equal.

i.e., ∠4 = ∠6

and ∠3 = ∠5

(iv) If a transversal intersects two lines such that a pair of alternate interior angles is equal, then the two lines are parallel.

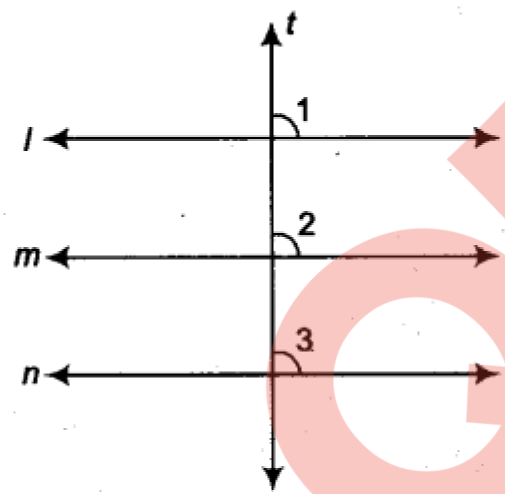
(v) If a transversal intersects two parallel lines, then each pair of interior angles on the same side of the transversal is supplementary.

i.e., $\angle 4 + \angle 5 = 180°$

and $\angle 3 + \angle 6 = 180°$

(vi) If a transversal intersects two lines such that a pair of interior angles on the same side of the transversal is supplementary, then the two lines are parallel.

12. **Lines Parallel to the Same Line:** If two lines are parallel to the same line, will they be parallel to each other.



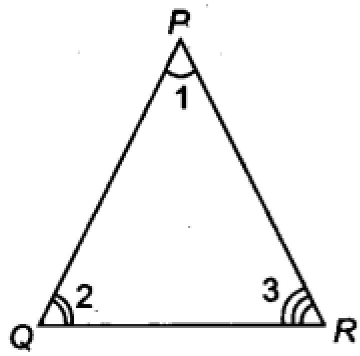
Here, line m parallel to line l and line n parallel to line l.

Hence, line m parallel to line n.

13. Angles Sum Property of a Triangle

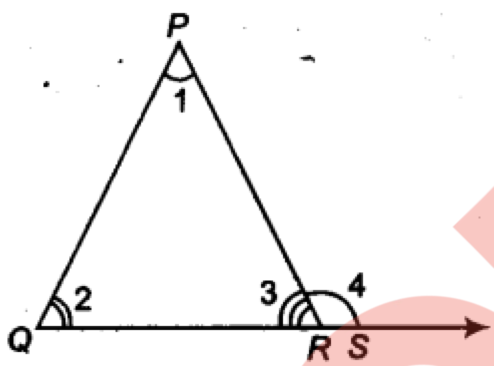
(i) The sum of the angles of the triangle is 180°

$\angle 1 + \angle 2 + \angle 3 = 180°$.



(ii) 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.

$\angle 4 = \angle 1 + \angle 2$



Note: An exterior angle of a triangle is greater than either of its interior opposite angles.