Verify that If Two Lines Intersect Each Other

OBJECTIVE

To verify experimentally that if two lines intersect each other, then

1. the vertically opposite angles are equal.
2. the sum of two adjacent angles is 180°.
3. the sum of all the four angles is 360°.

Materials Required

1. Cardboard
2. White paper
3. A full protractor
4. A nail
5. Two transparent strips marked as AB and CD
6. Adhesive

Prerequisite Knowledge

1. Basic knowledge of lines and angles.
2. Pair of angles; adjacent angles, linear pair of angles, vertically opposite angles.

Theory

1. **Lines and Angles**

1. **Line Segment:** A part of a line with two end points, is called a line segment. Line segment AB is denoted by $\bar{AB}$.

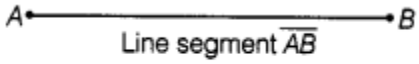

Fig. 11.1

A line segment has a definite length, which can be measured. The line segment $\bar{AB}$ is the same thing as the line segment $\bar{BA}$.

2. **Angle:** The figure formed by two rays with the same initial point, is called an angle.
In Fig. 11.2, the common initial point B is known as the vertex of the angle and the rays ($\overrightarrow{BA}$ and $\overrightarrow{BC}$) forming the angle are called its arms or sides.

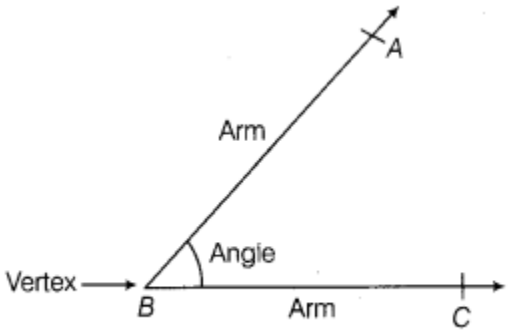

Fig. 11.2

There are different types of angles such as acute angle, right angle, obtuse angle, straight angle, reflex angle and complete angle, which are discussed below :

1. **(a) Acute Angle:** An angle whose measure is more than 0° but less than 90°, is called an acute angle.

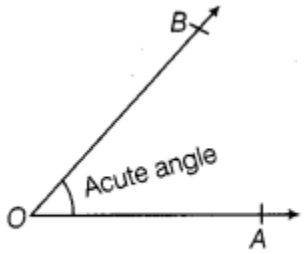

Fig. 11.3

In Fig. 11.3, ∠AOB is an acute angle.
Since, 0° < ∠AOB < 90°

2. **(b) Right Angle:** An angle whose measure is 90°, is called a right angle.

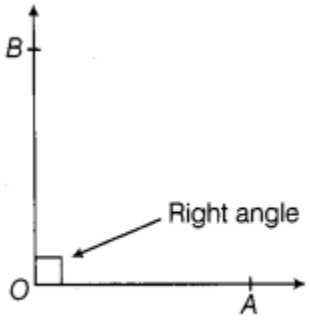

Fig. 11.4

In Fig. 11.4, ∠AOB is a right angle and BO ⊥ OA.

3. **(c) Obtuse Angle:** An angle whose measure is more than 90° but less than 180°, is called an obtuse angle.

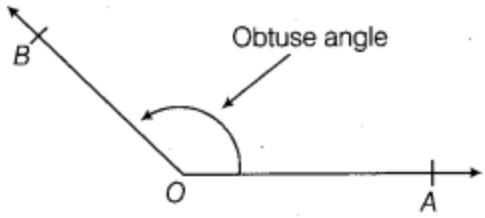

Fig. 11.5

In Fig. 11.5, ∠AOB is an obtuse angle.
Since, 90° < ∠AOB < 180°

4. **(d) Straight Angle:** An angle whose measure is 180°, is called a straight angle. In Fig. 11.6, ∠AOB = 180° is a straight angle.

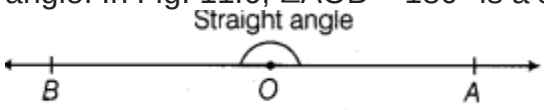

Fig. 11.6

A straight angle has two right angles.

5. **(e) Reflex Angle:** An angle whose measure is more than 180° but less than 360°, is called a reflex angle.

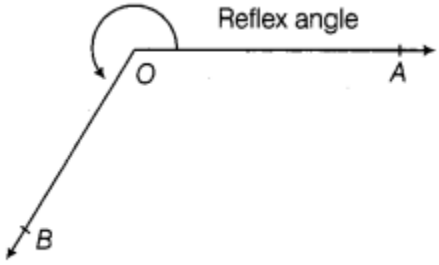

Fig. 11.7

In Fig. 11.7 and Fig. 11.8, ∠AOB and ∠PQR are reflex angles.
180° < reflex ∠AOB < 360°
180° < reflex ∠PQR < 360°

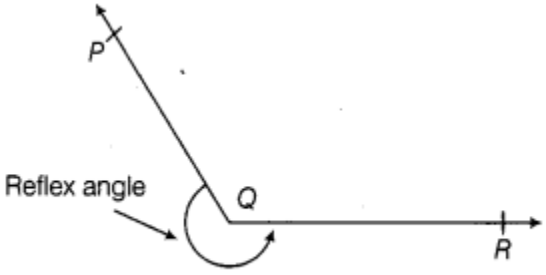

Fig. 11.8

6. **(f) Complete Angle:** An angle whose measure is 360°, is called a complete angle. In Fig. 11.9, ∠AOA = 360° is a complete angle.

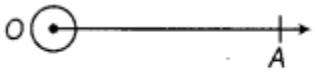

Fig. 11.9

2. **Pair of Angles**

There are some relations between the angles which are described below:

1. **Adjacent Angles:** Two angles are called adjacent angles, if

    1. **(a)** they have a common vertex,
    2. **(b)** they have a common arm and
    3. **(c)** their non-common arms are on different sides of the common arm.

    In Fig. 11.10, ∠AOC and ∠COB are adjacent angles because these angles have a common vertex 0, a common arm OC and non-common arms OA and OB are on different sides of the common ray OC.

    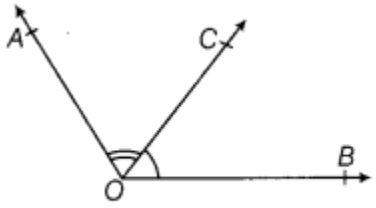

    Fig. 11.10

    When two angles are adjacent, then their sum is always equal to the angle formed by the two non-common arms. So, here ∠AOB = ∠AOC + ∠COB.

    Note Here, ∠AOB and ∠AOC are not adjacent angles because their non-common arms OC and OB lie on the same side of the common arm OA

2. **Linear Pair of Angles:** If the non-common arms of two adjacent angles form a line, then these angles are called linear pair of angles.

    In Fig. 11.11, ∠AOC and ∠BOC form a linear pair of angles.

    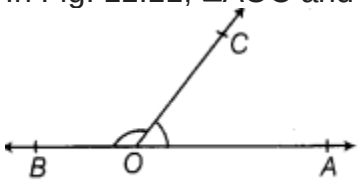

    Fig. 11.11

3. **Vertically Opposite Angles:** Two angles are called a pair of vertically opposite angles, if their arms form two pairs of opposite rays.

    In other words, when two lines intersect each other at a point, then there are two pairs of vertically opposite angles.

    In Fig. 11.12, lines AB and CD intersect each other at 0. So, ∠AOC and ∠BOD are vertically opposite angles. Also, ∠AOD and ∠BOC are vertically opposite angles.

    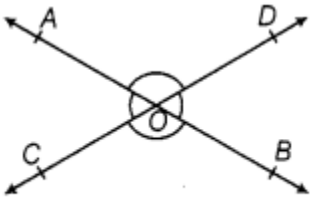

    Fig. 11.12

Procedure

1. Take a cardboard of suitable size and by using adhesive paste a white paper on it.
2. Also, paste a full protractor (0° to 360°) with the help of adhesive on the cardboard. (see Fig. 11.13)

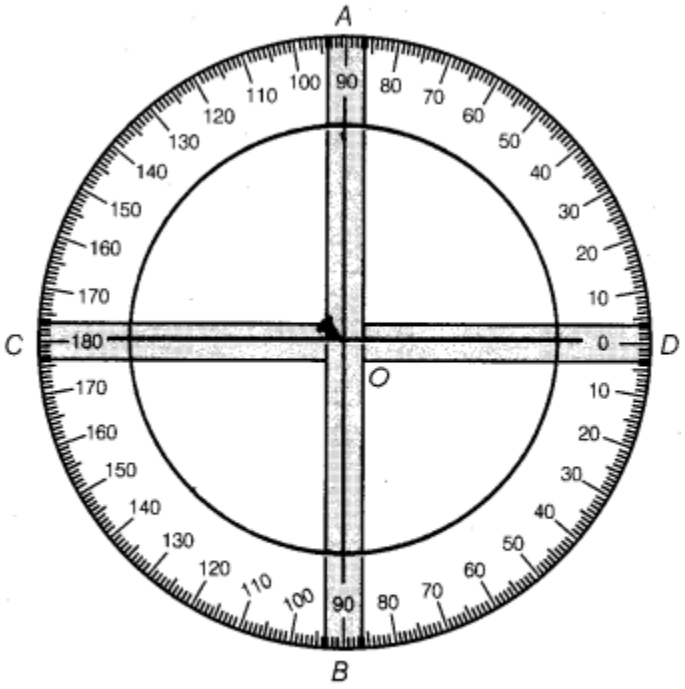

Fig. 11.13

3. Mark the centre of protractor as O.
4. Now, make a hole in the middle of both transparent strips which contain two intersecting lines.
5. Fix both strips at 0 by putting a nail, (see Fig. 11.13)

Demonstration

In the different positions of the strips, observe the adjacent angles and the vertically opposite angles.
In the different positions, also compare vertically opposite angles formed by the two lines. Check the relationship between the vertically opposite angles.
Check whether the vertically opposite angles, ∠AOD and ∠COB are equal.
Similarly, check whether the vertically opposite angles, ∠BOD and ∠AOC are equal.
Find the sum of two adjacent angles such that ∠AOD + ∠AOC which is equal to 180°.
i.e. ∠AOC + ∠COB = ∠COB + ∠BOD
= ∠BOD + ∠AOD =180°
Now, we obtain the sum of all the four angles formed at the point 0 and it is equal to 360°.

Observation

In one position of the strips, by actual measurement of angles

1. ∠AOD = …… , ∠AOC = …… ,
   ∠COB = …… , ∠BOD = …… ,
   Hence, ∠AOD = ∠COB and ∠AOC = ∠BOD (vertically opposite angles)
2. ∠AOC + ∠AOD = …… , ∠AOC + ∠BOC = …… ,
   ∠COB + ∠BOD = …… , ∠AOD + ∠BOD = …… (linear pairs)
3. ∠AOD + ∠AOC + ∠COB + ∠BOD = …… (angles formed at a point)

Result

We have verified experimentally that if two lines intersect each other, then

1. the vertically opposite angles are equal.
2. the sum of two adjacent angles is 180°.
3. the sum of all the four angles is 360°.

Application

These properties are very useful in several geometrical operations.

Viva Voce

Question 1:
What is the measure of a straight angle?
Answer:
180°

Question 2:
If the two adjacent angles are supplementary, then what does that mean?
Answer:
It forms linear pair.

Question 3:
What do you mean by a reflex angle?
Answer:
An angle which is greater than 180° but less than 360° is called a reflex angle.

Question 4:
If the angles are complementary, then what does that mean?
Answer:
Sum of the two angles is 90°.

Question 5:
What is the measure of the angle made at the centre of the circle?
Answer:
360°

Question 6:
If two angles are vertically opposite angles, where the measure of one of the angles is 30°, then what is the measure of other angle?
Answer:
30° because vertically opposite angles are equal.

Question 7:
If out of two angles of linear pair one is 60°, then what is the measure of other angle?
Answer:
In a linear pair, sum of both angles is 180°, so if one angle is 60°, then other angle will 180° – 60° = 120°.

Question 8:
How many points are required to draw an angle?
Answer:
To draw an angle three points are required.

Suggested Activity

To verify that if a transversal intersects two parallel lines, then

1. each pair of corresponding angles are equal.
2. each pair of alternate interior angles are equal.
3. each pair of interior angles on the same side of transversal, is supplementary.