



- Concept of angle
- Measure of angle (in degrees)
- Types of angles
- Construction of 60° and 120° angle with the help of ruler and compass

8.1 Introduction

You have read about the directions in previous class. You know very well that the Sun rises in the east. If we stand facing east, the direction in the back side is west. In this way the direction in the left hand side is North and the direction in the right hand side is South. There are total four directions viz. East, West, North and South. You certainly know that east-west and north-south are opposite directions of each other. Let us use this knowledge to learn angle and some of its properties.

Concept of Angle :

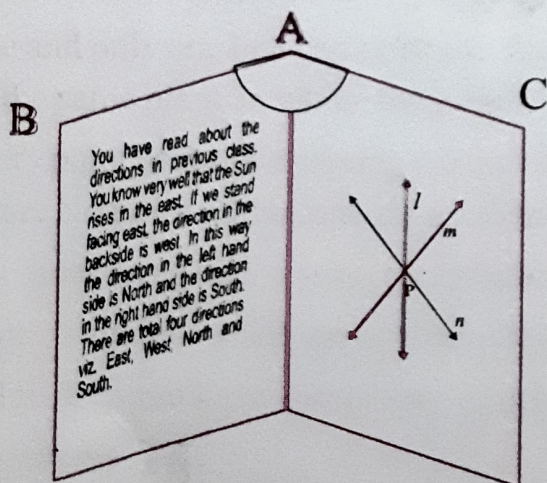


Fig. 1



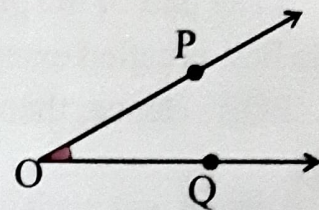
Fig. 2

In fig. (1), you can see that the edges AB and AC, of opened book, are inclined to each other. This gives a glimpse of angle. Similarly, in fig. (2), the inclination between the edge PQ and door frame PR of a door also gives a glimpse of an angle.

☞ Just do it :

Take two matchsticks and join one end of a stick to one end of the second sticks as shown in the figure.

Two matchsticks OP and OQ can be imagined as two rays $\overrightarrow{OP}$ and $\overrightarrow{OQ}$, O is the common point (starting point) in both these rays. Both these rays are forming an angle.

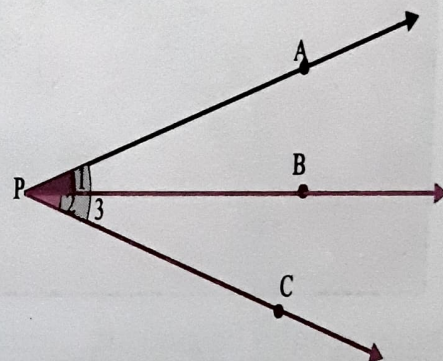


Two rays, with common starting point, forms an angle. Angle is represented by the symbol $\angle$. The rays which form the angle are called its sides.

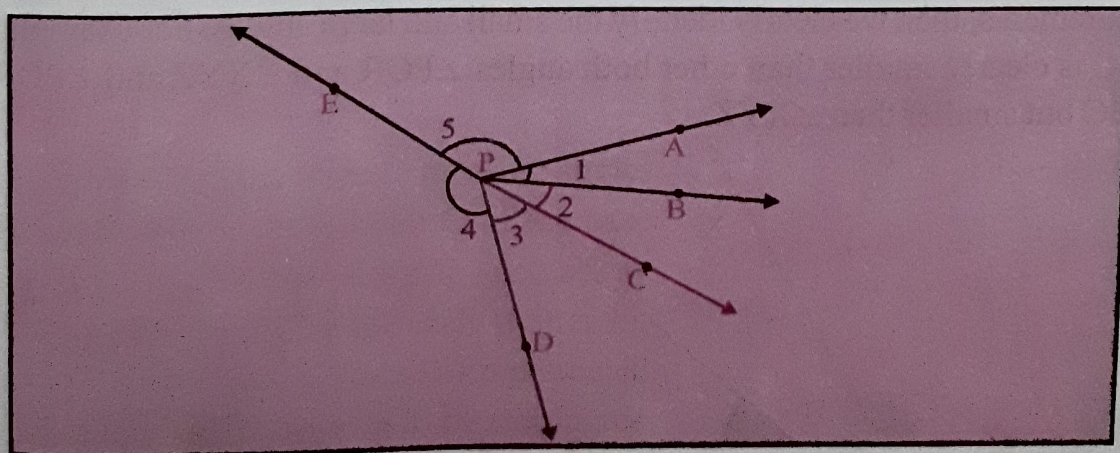
An angle made from rays $\overrightarrow{OP}$ and $\overrightarrow{OQ}$ is shown in the above figure. O is the vertex of this angle. We use an arc (part of a circle) at the vertex O to represent the angle. It is denoted by $\angle POQ$.

Argue and Discuss :

See the adjacent figure, can we call all angles forms at angle P as $\angle P$? Here we see that $\angle P$ can be used as $\angle 1 = \angle APB$, $\angle 2 = \angle CPB$ and $\angle 3 = \angle APC$, but every angle is mutually different. Therefore, if there are several angles at a point, then while writing angles, we use three letters to denote the angle and write the letter corresponding to the vertex in the middle.



☞ Try it :

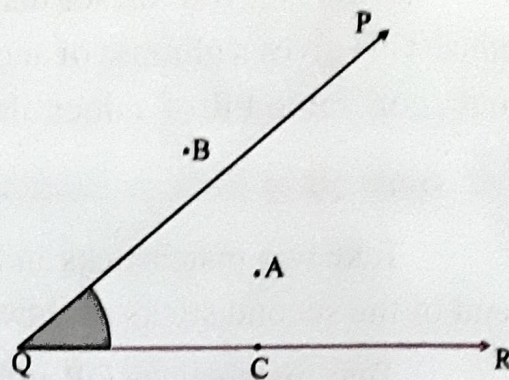


Write the names of angle represented by numbers 1, 2, 3, 4 and 5 in the figure.

8.2 Interior and Exterior Part of an Angle :

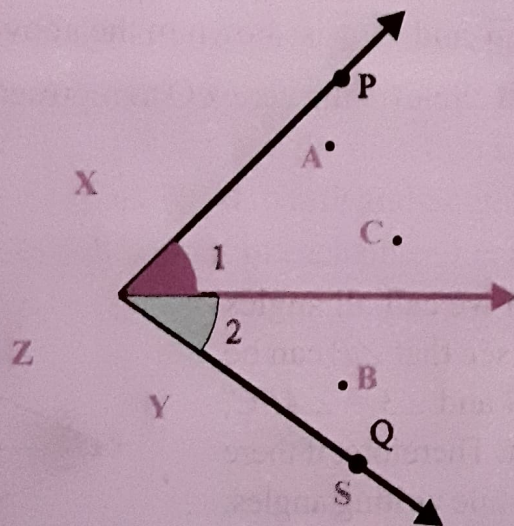
See the adjacent $\angle PQR$. This angle divides the plane in two parts. One part contains all the internal points of the angle (Like A). This part of the plane is called interior.

The part of the plane, where the points outside the angle lies, is called exterior part of the angle. Point C lies on $\angle PQR$. Hence, there are three regions related to the angle.



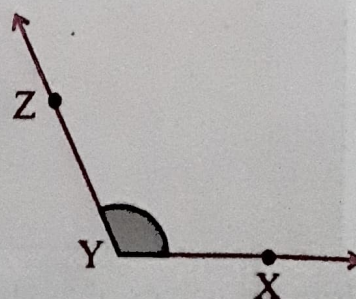
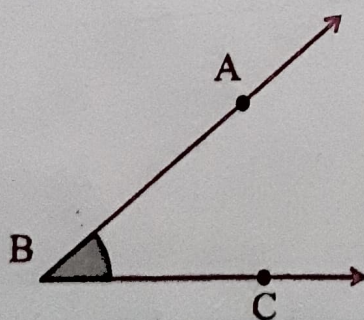
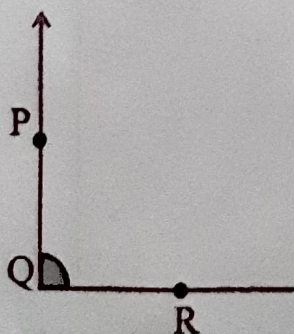
☞ Try it :

In the adjacent figure, write the interior and exterior points of $\angle 1$ and $\angle 2$ respectively.

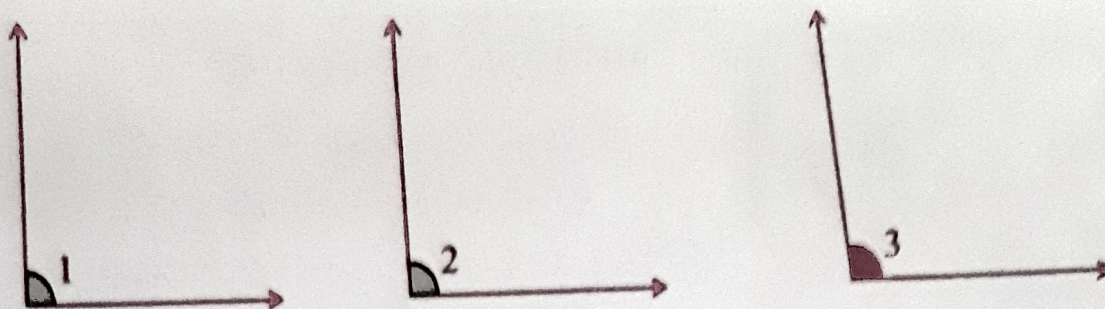


Comparison of angles :

If we compare two or more angles, then we see that when there is more difference in their measurements, then we clearly identify the small and large angles. For example, it is seen that $\angle ABC$ is clearly smaller than other both angles $\angle PQR$ and $\angle XYZ$ and $\angle PQR$ is larger than $\angle ABC$ but smaller than $\angle XYZ$.

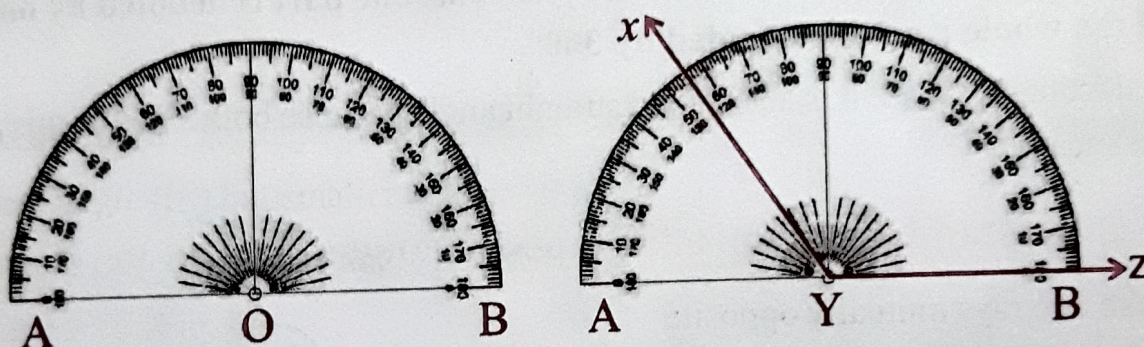


Again, see the following figure.



See $\angle 1$, $\angle 2$ and $\angle 3$ in the figure. Can this be told after observing them that which angle is larger and which angle is smaller? Here we see that the difference among inclinations of these three angles is very small such that it cannot be told after looking that which angle is smaller and which angle is larger. Therefore, it is necessary to measure them for comparative study of angles with greater precision. The equipment used to measure angles is called protractor.

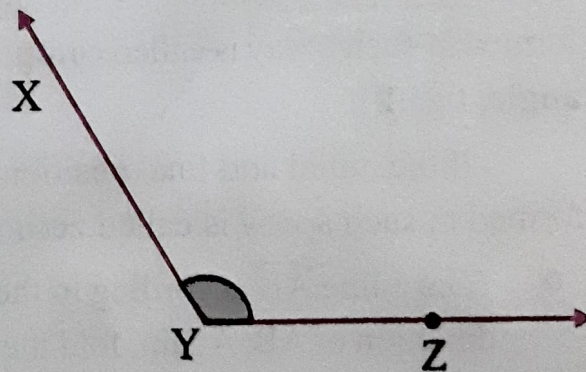
Protractor :



This is a semicircular equipment used to measure an angle. Its curved edge is equally divided into 180 divisions. Each division is called a degree. It consists of marks from 0° to 180° in both directions (clockwise and anti-clockwise). As clear from the picture, AB is base and O is its mid-point.

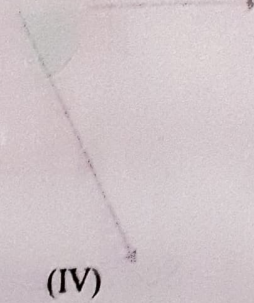
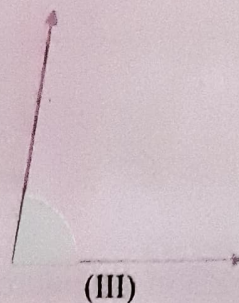
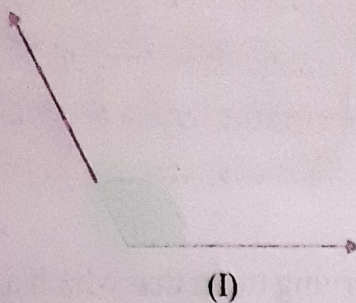
Measurement of angle :

Let us understand the ways to measure angles by adjacent angle. Put the mid-point O of the base AB of the protractor at Y and adjust in such a way that ray YZ coincides OB. Read the scale written on the protractor that meets ray YX. The mark represented by the ray YX at the curved edge will be the degree value of the angle. It is written as $\angle XYZ = 125^\circ$.



Try it out :

Measure the following angles and write their measures :



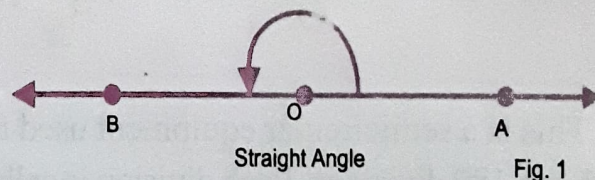
8.3 History of unit of measure of an angle :

The people of Babylonia did not know as much about the motion of the sun and the moon as today we people have. They continued to realize that the sun is always in the sky at 360 days in a fixed position. Those people divided this complete single round into 360 equal parts and each part written as one day of the year. **This one part is denoted by one degree (1°) and the whole round is denoted by 360° .**

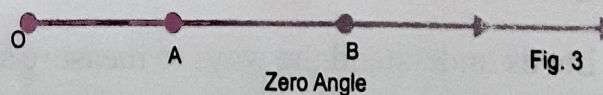
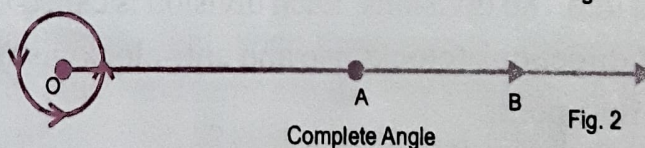
Half round is 180° . It is also called straight angle because both sides of this angle are in straight line.

Let us understand some specific types of angles :

Take two rays mutually opposite through a point O of a line. Thus the angle formed by two opposite rays at the point O of a line is called **straight angle**, fig. (1).



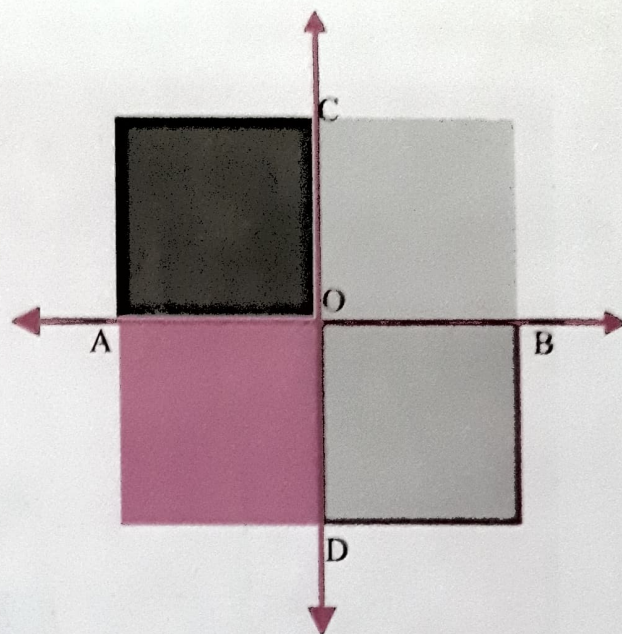
If a ray coincides with its initial position after completing full rotation once about its starting point, then the angle formed in such a way is called **complete angle**, fig. (2).



If the initial and final positions of a ray coincide without any rotation, then the angle formed in such a way is called **zero angle**, fig. (3).

- Take a line $\overleftrightarrow{AB}$ according to the diagram on the rectangular or square paper. Fold it in direction of AB. Again, fold the paper in such a way that one part of AB coincides with

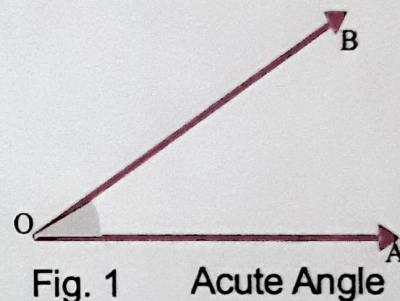
other part of it. Denote the second fold by CD. We see that O is the common point of the folds of paper. Now there are four angles $\angle BOC$, $\angle COA$, $\angle AOD$ and $\angle DOB$ forms at point O. Measure these angles by a transparent paper. We observe that these four angles are mutually equal. Each of these angles are called **right angle**.



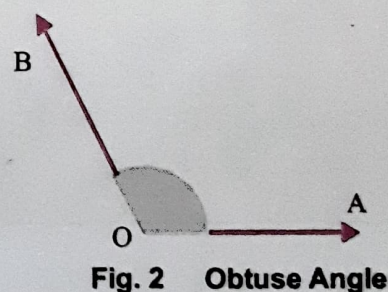
8.4 Types of angles

We have studied about the **right angle**, **straight angle**, **complete angle** and **zero angle**. Now we will study about some other types of angles.

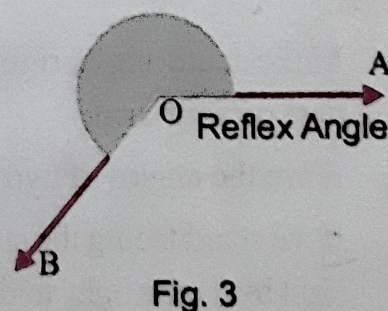
Acute angle : An angle which is greater than a zero angle (0°) but smaller than a right angle (90°) is called an **acute angle** i.e., $90^\circ > \text{acute angle} > 0^\circ$. Fig. (1)



Obtuse angle : An angle which is greater than a right angle (90°) but smaller than a straight angle (180°) is called an **obtuse angle**, i.e., $180^\circ > \text{obtuse angle} > 90^\circ$. Fig. (2)

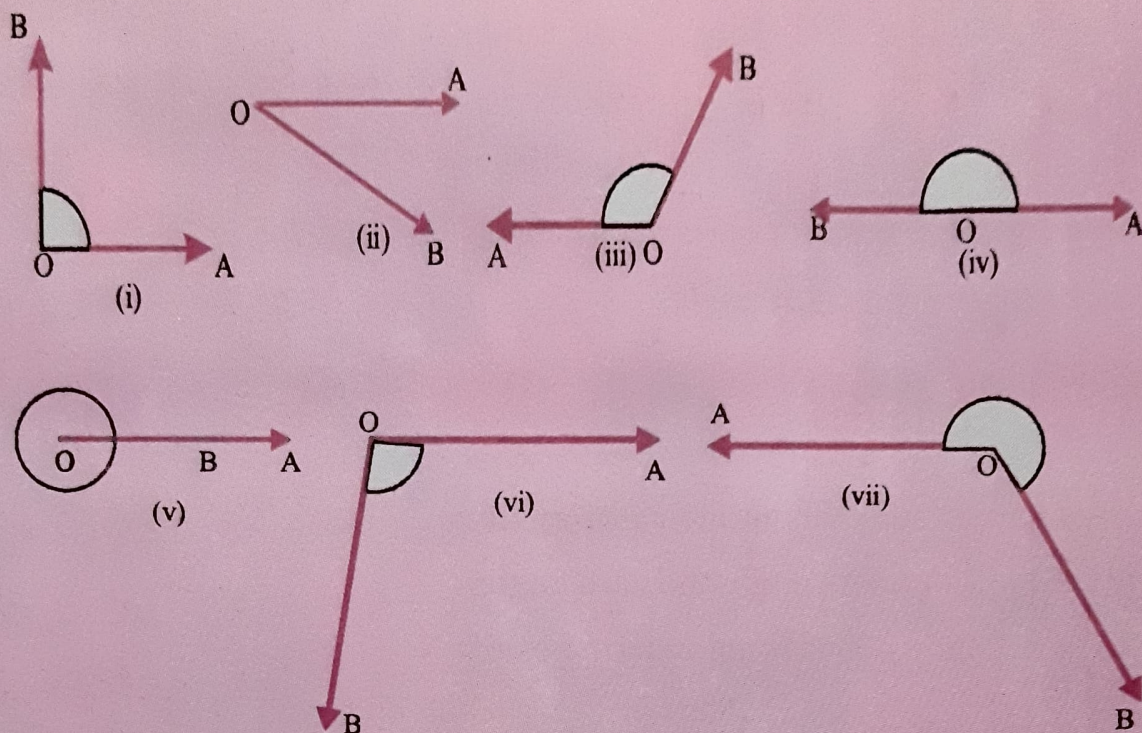


Reflex angle : An angle which is greater than a straight angle (180°) but smaller than a complete angle (360°) is called a **reflex angle**. i.e., $360^\circ > \text{reflex angle} > 180^\circ$. Fig. (3)



Try it :

See the following shapes and write the types of the angle.



- Which type of angle is 280° ?
- Draw an acute angle. Measure it.
- Draw an obtuse angle. Measure it and how the angle smaller than the straight angle.
- Identify the acute angle, obtuse angle and reflex angle among the following angles and write them in your exercise book.

210° , 147° , 10° , 300° , 54° , 178° , 91°

Do it too

Activity

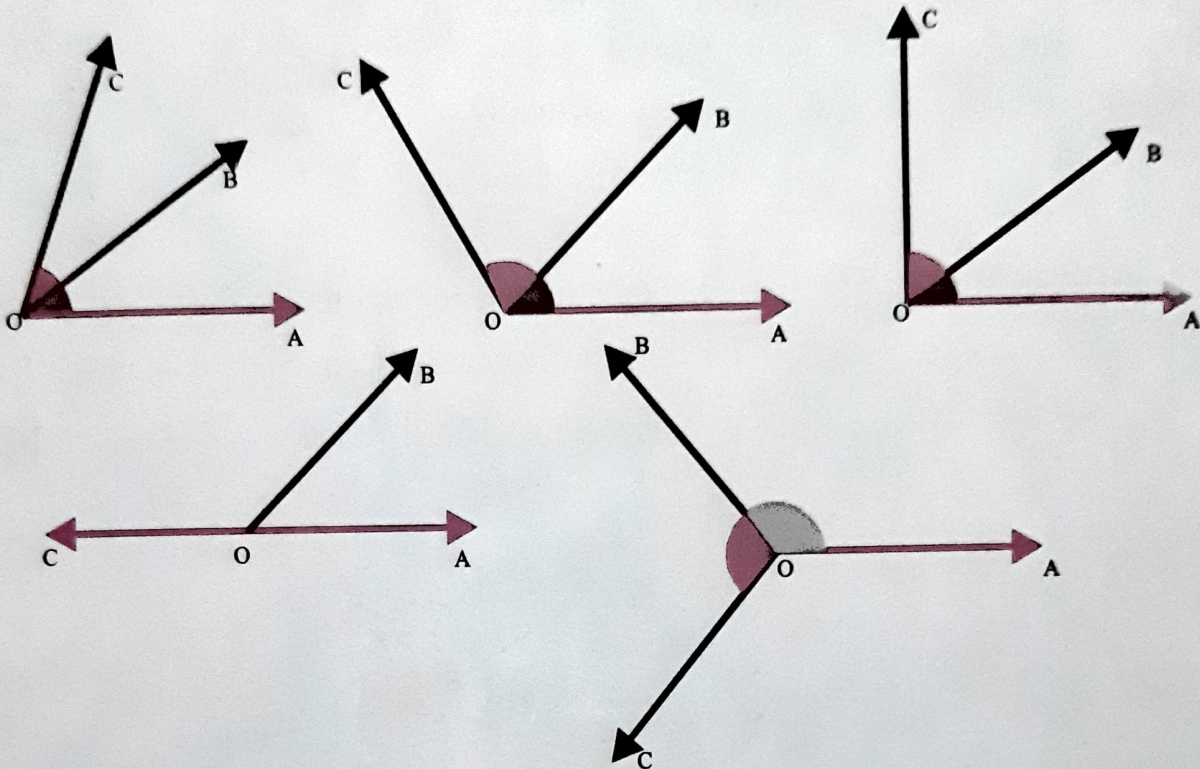
1. Make acute angle, right angle and obtuse angle on the elbow using upper and lower part of your arm.
2. Form the angles of two adjacent fingers. How many angles can be made in this way ?
3. If we stand facing the sun in the morning then in which direction will it face, if we turn right by (i) one right angle (ii) two right angles (iii) three right angles (iv) four right angles.
4. Take a watch having hour and minute hand. Ring three, six, nine and twelve in the clock. In each condition see how many degrees of angle are formed between them ?

5. Take protractor, scale and pencil and draw acute angle, right angle, obtuse angle, straight angle, reflex angle and complete angle using them.

Pair of angles

The angle twins which have the common vertex are called pair of angles. Some types of pair of angles are in the following diagrams.

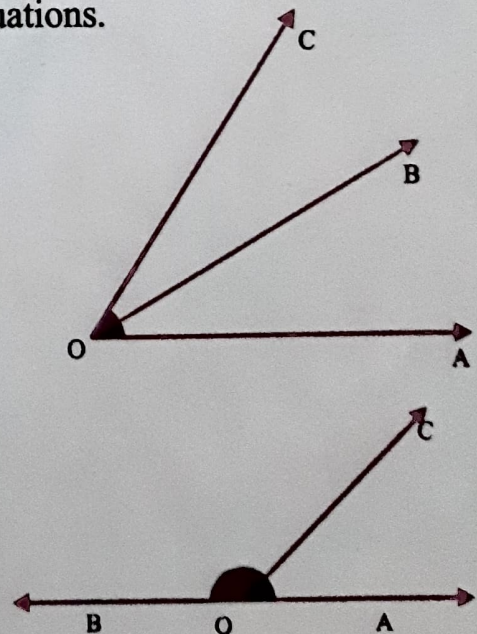
See the following diagrams :



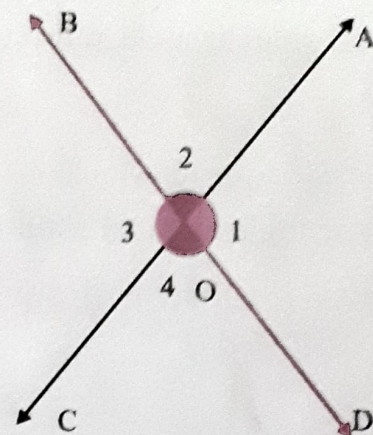
We see that in the adjacent figure the angles have the common vertex. On the common vertex there are forming different types of pairs of angles. These angle twins are called pairs. We will study the angle pairs formed by these different situations.

Adjacent angle : See the adjacent figure. There are two angles AOB and BOC in it which has only common vertex O and common side OB. Therefore, those angle pairs which has a common vertex and the sides OA and OC are situated on opposite direction of the common side, are called adjacent angles.

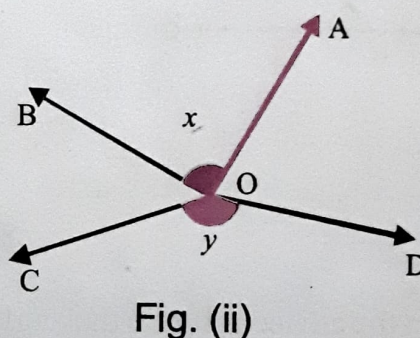
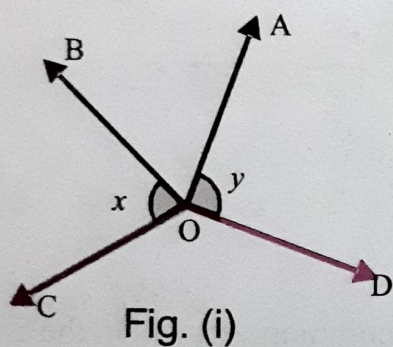
Linear Pair : See the adjacent figure. Here angle AOC and angle COB are adjacent angle. Common vertex is O and common side is OC. Sides OA and OB are opposite rays. The pair of such adjacent angle is called linear pair of an angle. The sum of angles of such linear pair is two right angles.



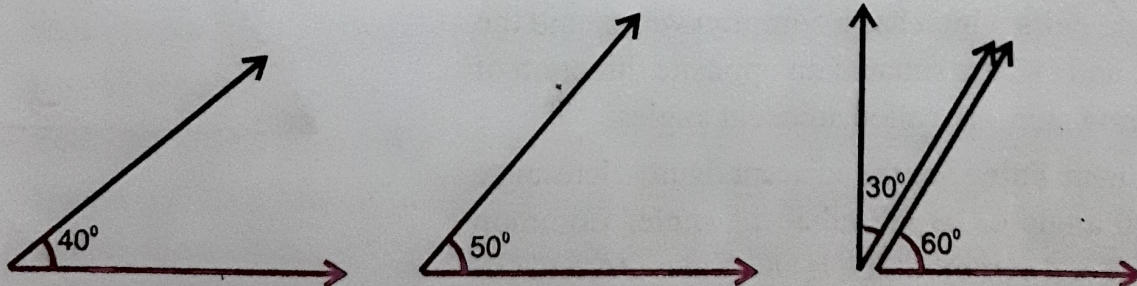
Vertically opposite angles : In the adjacent figure, two lines AC and BD intersect at point O, thereby four angles are formed at point O. Look at the figure to tell which angles are the linear pairs? We see that pairs $\angle 1$ and $\angle 2$; $\angle 2$ and $\angle 3$; $\angle 3$ and $\angle 4$; $\angle 4$ and $\angle 1$ are linear pairs. Look at the figure again to tell which angles are not linear pairs? We see that pairs $\angle 1$ and $\angle 3$; $\angle 2$ and $\angle 4$ are not linear pairs. Hence, when two lines intersect then the two angles formed by them, in which no side is common, are called **vertically opposite angles**. In this way, $\angle 1$ and $\angle 3$ and $\angle 2$ and $\angle 4$ are vertically opposite angles.



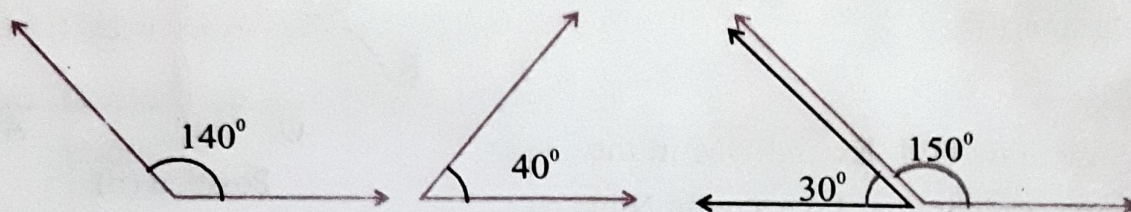
- Look at the following figures and make similar angles on your exercise book.
 - Tell whether the angle x and angle y are vertically opposite of angles in fig. (i) ?
 - Tell whether the angle x and angle y are vertically opposite of angles in fig. (ii) ?



Complementary angles : See the following diagrams. If the sum of angles is 90° then these angles are called complementary angles of each other. For example, 40° , 50° , and 30° , 60° etc.

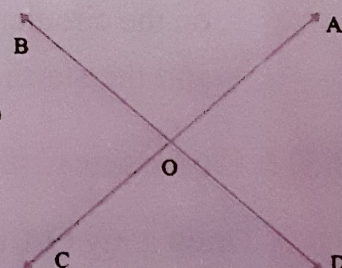


Supplementary angles : See the following diagrams. If the sum of angles is 180° then these angles are called supplementary angles of each other. For example, 40° , 140° and 30° , 150° etc. Therefore, it is clear that it is not necessary to have a common vertex and adjacent angle in complementary and supplementary angles.



Try :

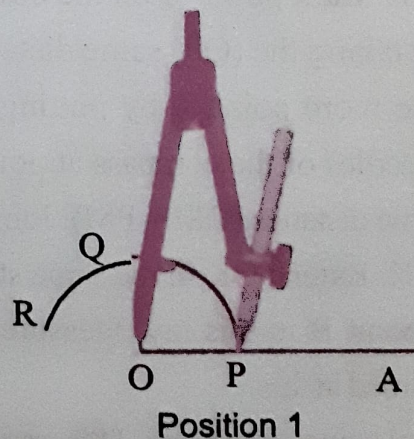
- Write the complementary angle of the following angles.
(i) 20° (ii) 55° (iii) 68°
- Write the supplementary angle of the following angles.
(i) 45° (ii) 70° (iii) 120°
- Which of the following angle pairs are complementary and supplementary ?
(i) 48° , 42° (ii) 135° , 45° (iii) 160° , 20°
- Tell the name of linear pairs and vertically opposite angles in the adjacent figure.



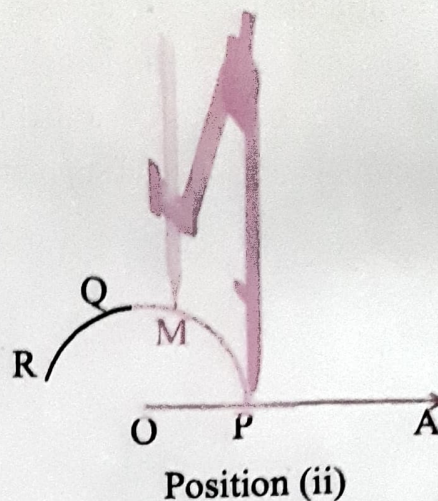
8.5 Construction of different types of angles :

8.5.1. Construction of 60° angle

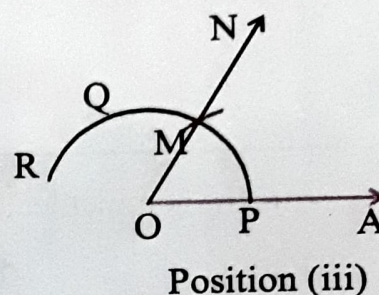
- Draw a ray OA in your exercise book. Now draw a circular diagram PQR of some distance by putting the pointy end of the compass at the starting point O. This circular diagram cuts ray OA at point P. Position (i).



(ii) Take the distance OP and make a mark on the circular diagram (arc) PQR with pencil end by putting the pointy end of the compass at point P at the same distance. This point is M . Position (ii).



(iii) Now draw OM . Extend OM in the same straight line. Take a point N in this ray. Measure the angle AON formed in this way using protractor. This angle must be 60° . Position (iii).

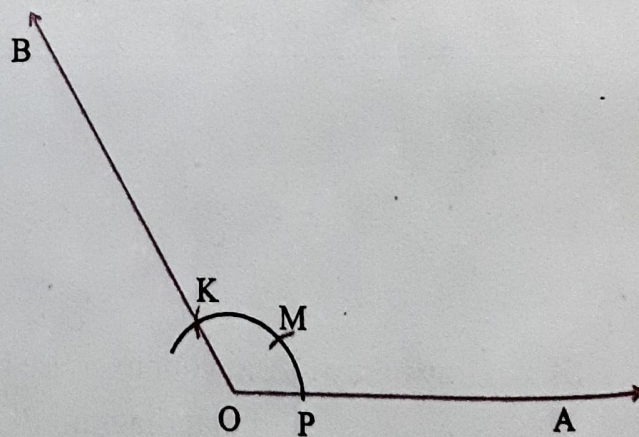


Thus, draw a circular arc of some length by putting the pointy end of compass on starting point O of a ray

OA as shown in the figure, which meets the ray at P . Again, mark the same distance on the circular arc from P . Then, the angle between the ray joining the marked point and the starting point O and ray OA will be 60° .

8.5.2 Construction of 120° angle :

Draw a ray OA in your exercise book. Draw a circular arc by putting the pointy end of compass on starting point O , which cuts the ray at P . Mark point M on the circular arc from P by taking the (OP) same distance. Now, mark one more point K by putting the pointy end (needle) of the compass at point M and taking same distance $(OM = PM)$. Join starting point O to K . Extend OK in the same straight line. Take a point B in this ray. Measure the angle AOB formed in this



way using protractor. This angle must be 120° . Similarly, the angles of multiplies of 60° , i.e., 180° , 240° etc. can be constructed.

Group discussion on the following topics and draw conclusions :

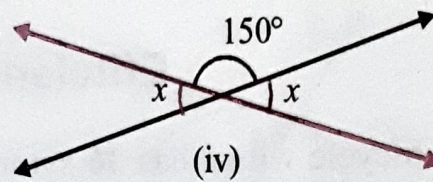
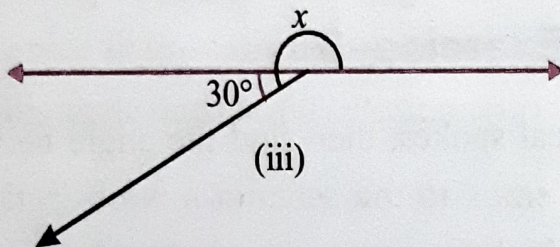
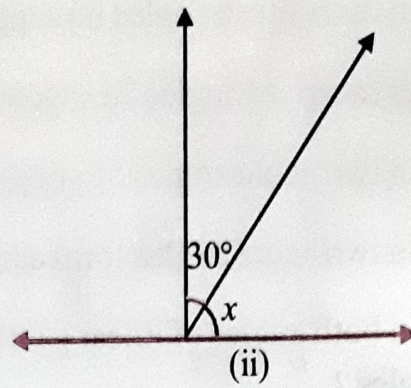
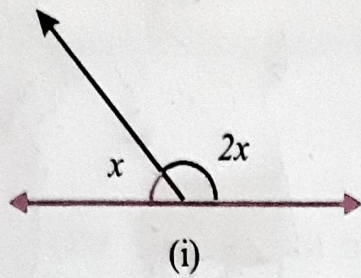
- (i) Can two obtuse angles be supplementary ?
- (ii) Can two right angles be supplementary ?
- (iii) Can two acute angles be supplementary ?
- (iv) Can two acute angles form a linear pair ?
- (v) Can both angles of linear pair be obtuse angles ?



Efficiency Exercise-8

1. If a bicycle wheel has 36 symmetrical spokes, then find the angle between two adjacent spokes.
2. Find the supplementary angles of angles 60° , 120° , 140° , 150° .
3. While doing exercise when the student is directed to :
 - (i) Turn back, how many degrees does he turn ?
 - (ii) Turn right, how many degrees does he turn ?
4. Classify and write the following angle by their measure.
 0° , 30° , 90° , 135° , 180° , 225° , 360°
5. Answer the following :
 - (i) The complementary angle of acute angle is
 - (ii) The supplementary angle of acute angle is
 - (iii) The supplementary angle of a right angle is
 - (iv) The supplementary angle of an obtuse angle is
6. Find the complementary angle of the following angles :
 - (i) 30° (ii) 60°
 - (iii) 40° (iv) 50°

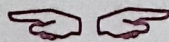
7. Find the value of "x" in the following figures.



8. How many division of a complete angle can be made in multiple of 60° . Verify it using ruler and compass.
9. Construct an angle of 300° by using ruler and compass.

In this unit we learnt about :

1. What is an angle ? How many types of angles are there ?
2. The meaning and inter-relations of complementary angles and supplementary angles, adjacent angle, vertically opposite angle, linear pair etc.
3. Construction of different angles using ruler and compass.



ANSWERS

Efficiency Exercise 8

1. 10° 2. 120° , 60° , 40° , 30° 3. (i) 180° , (ii) 90° ,
4. Zero angle, acute angle, right angle, obtuse angle, straight angle, reflex angle, complete angle,
5. (i) acute angle, (ii) obtuse angle (iii) a right angle (iv) acute angle
6. (i) 60° , (ii) 30° , (iii) 50° , (iv) 40° ; 7. (i) 60° , (ii) 60° , (iii) 210° , (iv) 30° ; 8. Six.

