CHAPTER - 5

Measures of Lines and Angles

5.1 Introduction

In the chapter 'Basic Geometrical Ideas', we learnt about some geometrical shapes. These included lines, angles, triangles quadrilaterals and circles. Many of these are made of line segments and angles formed by them. We can see these shapes, lines and angles have different sizes. We can often compare the lengths of line segments and the measures of angles between them by looking at them.

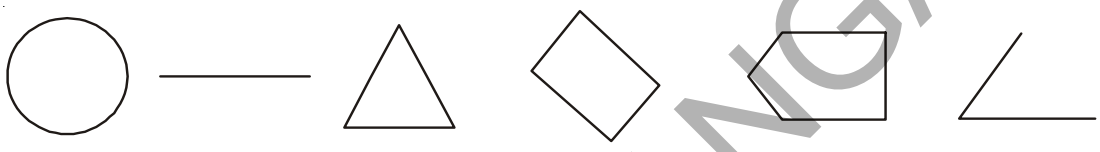


fig. 5.1

This is not however possible all the times. Some times the measures are so close to each other that we require an accurate tool/device to measure these measurements.

5.2 Measure of A Line Segment

The edges of a book, TV screen, bricks etc. are like a line segment drawn through any edge.

We have drawn and also seen so many line segments. We know that a triangle is made of three and a quadrilateral of four lines segments.

A line segment is a part of a line with two end points. This makes it possible to measure a line segment. This measure of each line segmenet is its "length". We use length to compare line segments.

fig. 5.2

We can compare the 'length' of two line segments by:

a. Simple observation. b. Tracing on a paper and comparing c. Using instruments.

The line segments $\overline{AB}$ and $\overline{CD}$ in the figure 5.2 can be compared by simple observation. Can you find the longer one?

$\overline{AB}$ is clearly longer than $\overline{CD}$.

But it is difficult to compare the lengths of the another two pairs $\overline{PQ}$ and $\overline{RS}$ shown in the figure 5.3. Why?

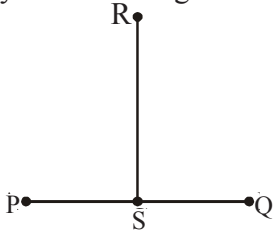


fig. 5.3

THINK AND DISCUSS

How can we compare them?

To compare them, we trace the line segments $\overline{AB}$ and $\overline{CD}$ on a tracing paper such that they are roughly aligned in the same direction.

We can now say $\overline{AB}$ is longer than $\overline{CD}$. In the same way we can compare $\overline{PQ}$ with $\overline{RS}$. We can see $\overline{PQ}$ and $\overline{RS}$ are of equal length.

5.2.1 Comparing by instruments

To compare any two line segments accurately, then we need proper instruments. These include the ruler (scale) and divider in the Geometry box.

Have you seen and used these instruments? Look at these carefully.

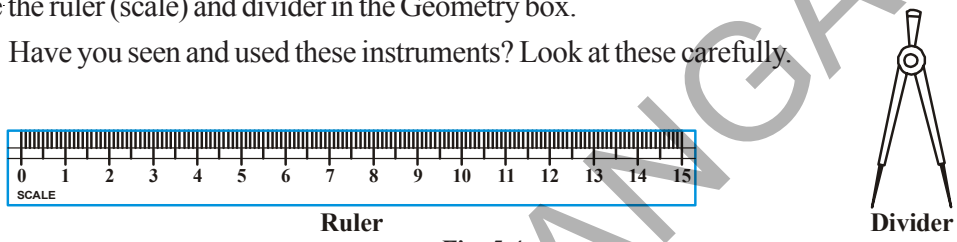
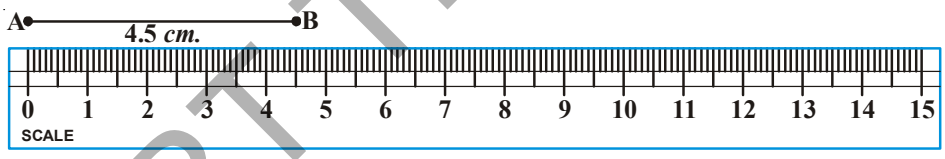


Fig. 5.4

A ruler (scale) is divided into 15 big parts as marked along one of its edges. Each of these 15 parts is of length 1 centimeter (1 cm.) Each centimeter is divided into 10 parts again and each sub part is 1 millimeter (1 mm.)

Let us see how to measure the length of a line segment using the ruler.



Place the zero mark (cm.) of the ruler at A. Read the mark against B. This gives the length of AB line segment.

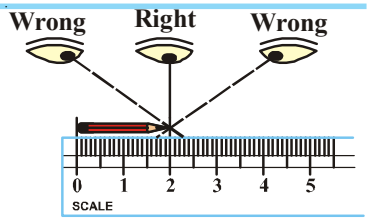
Here length of AB = 4.5 cm. i.e. AB = 4.5 cm.

Note: Let us assume that we place the 1 mark (cm) of the ruler at A. Then the mark against B would be 5.5cm. Then we need to read both the points and subtract to find the length.

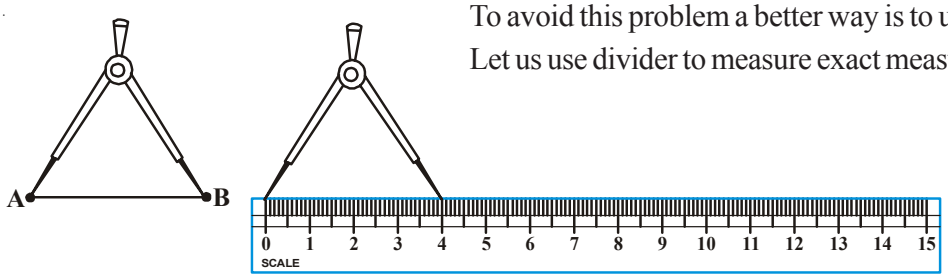
i.e.,5.5 - 1 = 4.5 cm.

THINK, DISCUSS AND WRITE

What other errors can you find while measuring the length of line segment?



For example, to find the length of a pencil, the eye should be correctly positioned as shown in the figure i.e. just verticially above the mark for both points. Other wise there may be an error due to angular viewing.



To avoid this problem a better way is to use a divider?
Let us use divider to measure exact measure.

fig. 5.5

Open the divider. Place the end point of one of its arms at 'A' open it till the end point of the second arm is placed at B. Lift the divider carefully without disturbing the opening of the divider place it on the ruler. Read the marks against each end point.

What is the length of line segment AB?

Take more line segments. Measure their lengths.

TRY THESE

1. Take a post card and measure the length and breadth with ruler and divider. Do all post cards have the same dimensions?
2. Select any three objects like eraser, small pencil, etc. Trace their length on a paper. Measure the length of these line segments.

EXERCISE - 5.1

1. Give any five examples of line segment observed in your classroom.
   Eg.: edge of black board.
2. Why is it better to use a divider than a ruler, while comparing two line segments?
3. Measure all the line segments in the figure given below and arrange them in the ascending order of their lengths.

Line Segments $\overline{AB}$, $\overline{AC}$, $\overline{AD}$, $\overline{AE}$, $\overline{BC}$, $\overline{BD}$, $\overline{BE}$, $\overline{CD}$, $\overline{CE}$, $\overline{DE}$

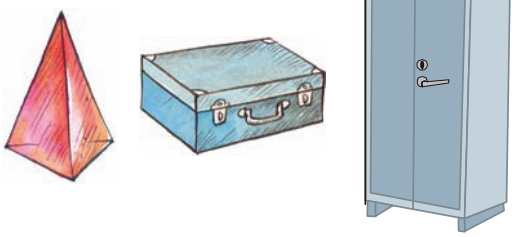
4. Mid point of $\overline{AB}$ is located by Swetha and Reshma like this.

Swetha

Reshma

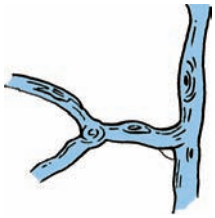
Which one do you feel correct? Measure the lengths of $\overline{AC}$, $\overline{CB}$ and verify.

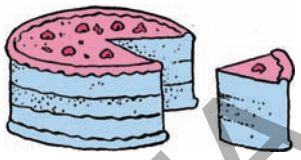
5. Each of the figures given along side has many line segments. For the almirah we have shown one line segment along the longer edge. Identify and mark all such line segments in these figures.



5.3 Measure of an angle

We see angles around us all the time.





We know as the line segments of the blade of scissors move further apart, the measure of the angle between them increases. Angle is formed between two rays or two line segments.Give some examples of things where we can see angles.

Activity

Look at the following figures:

Put your hands close to your body. Keep one hand in the same position and slowly move up the other hand. As you go on moving your hand; you can observe the angle between your body and moving hand changes.

Let us consider the different angles formed and what we call them?

Initially the arm was along the body. As you move the arm up the angle increases.

In figure (iii) your arm is perpendicular to your body. The angle formed by your arm with your body is exactly 90° which is called a right angle.

In figure (ii) the angle formed between your body and hand is less than a right angle. Such angles are called acute angles.

In figure (iv) the angle formed is more than a right angle and it is called an obtuse angle.

In figure (v) your hand is again along your body and the angle formed is 180°. This is called a straight angle.

Now, in fig.(i) do you find any angle between your hand and your body?

There is no angle formed. So here we say that it is zero angle and we started moving from zero angle. Notice the figures are now pointing up and not down. This indicates that we have not reached the initial position.

Let us observe some other examples of these angles formed in a clock:

If we take, the angle between the hands to be zero at 12'O clock.


(i)


(ii)


(iii)

Which clock's hands are showing acute angle.

In which figures the clock's hands form an obtuse angle.

These angles would be measured using the small i.e. hours hand as a base and we will measure the clockwise movement of the minutes hand away from the hour's hand.

ACTIVITY

Take two drinking straws

Keep one end of the one straw over the other straw end and fix a pin at that point as 'L' shape.

Here you find a right angle tester (*fig. 5.6*). This is an "angle apparatus".

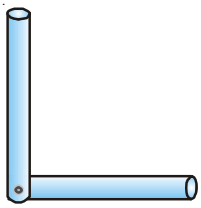


fig. 5.6

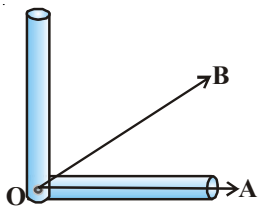


fig. 5.7

Keep the tester on one ray $\overrightarrow{OA}$ coinciding with vertex as shown in the *(fig.-5.7)*. Now ∠AOB is less than the right angle. Thus it is an acute angle.

Keep the tester on one ray $\overline{OC}$ coinciding with the vertex as shown in the *(fig.-5.8)*. Now ∠COD is more than the right angle. Thus it is an obtuse angle.

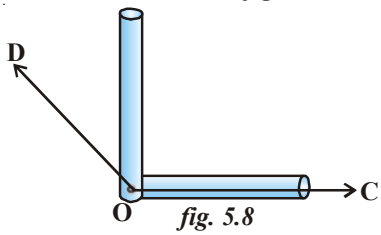
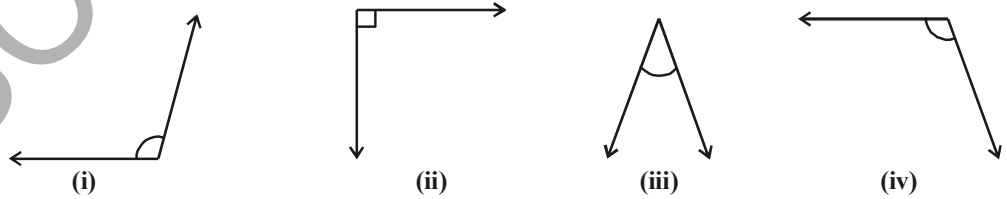


fig. 5.8

TRY THESE

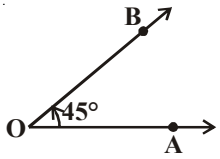
1. Use the 'straw angle apparatus' and identify the following angles.


(i) (ii) (iii) (iv)

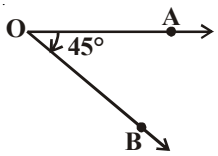
2. List out five daily life situations where you observe acute angles and obtuse angles.

3. Draw some angles of your choice. Test them by the 'angle apparatus' and write which are acute and which are obtuse.

Satya and Swetha were given Ray $\overrightarrow{OA}$ and were asked to draw 45° angle. They drew like this:



Satya (∠AOB = 45°)



Swetha (∠AOB = 45°)

What is the difference in the angles drawn by Satya and Swetha?

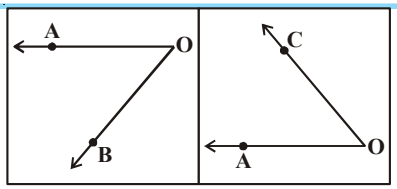
In the angle made by Satya, $\overrightarrow{OA}$ moved in the opposite direction of the hands of a clock and reached $\overrightarrow{OB}$, making an angle of 45°. Such **angles where the ray moves in the opposite direction of the hands of a clock are called Anti clock-wise angles.**

The anti clock-wise angles are denoted by a positive measure. So Satya's angle is 45^{o}.

In the angle made by Swetha, $\overrightarrow{OA}$ moved in the direction of the hands of a clock and reached $\overrightarrow{OB}$, making an angle of 45°. Such **angles where the ray moves in the direction of the hands of a clock are called clock-wise angles**. They are denoted by negative sign. The angle made by Swetha is of -45^{o}.

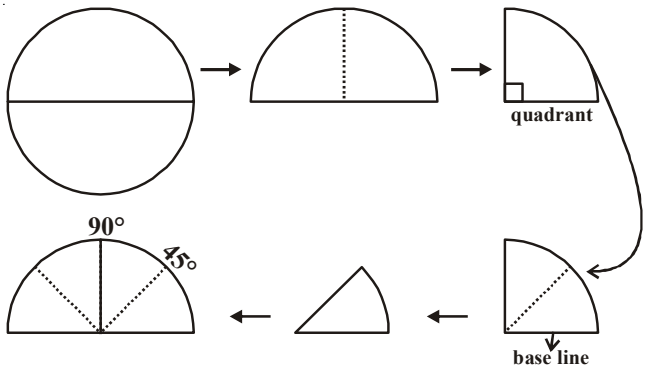
Think, Discuss and Write

In the adjascent figure ∠AOB and ∠AOC are given. Which angle is clock-wise and which angle is anti clock-wise. Think and discuss with your firends.



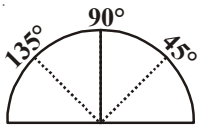
Activity

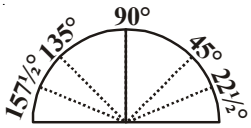
1. Cut out a circular shape using a bangle or take a circular sheet.
2. Fold it once from the middle, you will get a semi circle.
3. Fold it once again to get a shape as shown. This is called a quadrant.
4. The fold is at 90° to the edge. Mark 90° on the fold.
5. Now fold the quadrant once more as shown. The angle is half of 90° i.e. 45°.
6. Open it out now. What is the angle upto the new line? Mark 45° for the angle formed between crease and the baseline.



7. Mark the measure of the fold on the other side of 90°.

It would be 90° + 45° = 135°.



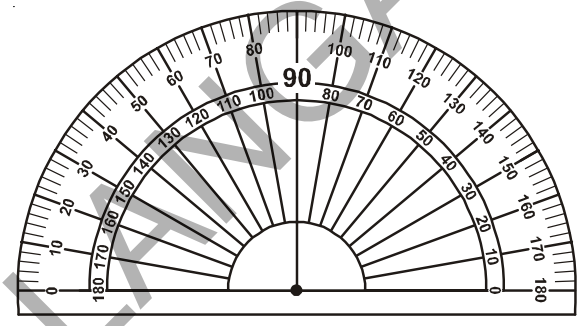


8. Fold the paper again upto 45° (half of the quadrant). Now make half of this. The first fold to the left of the base line now is half of 45° i.e. 22½°. The angle on the left of 135° would be 157½°.

You have got a ready device to measure angles. This is an appropriate protactor.

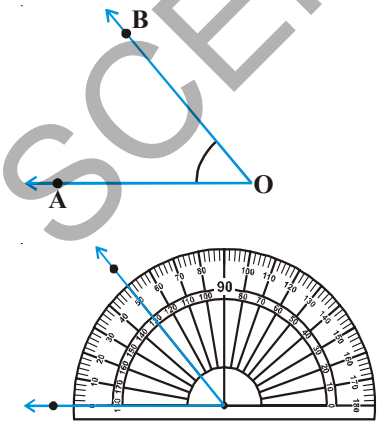
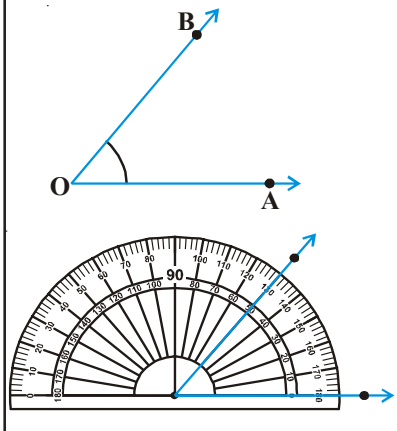
5.3.1 The Protractor

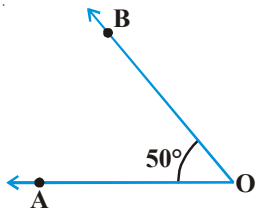
The improvised 'Right angle tester' we made is helpful to compare angles with a right angle. But this does not give a precise comparison. So in order to compare and measure angles more precisely we need an instrument, which is **'a protractor'**.



If you look at the protractor carefully, you will see that there are two set of measurements. Find out the line which shows right angle how much it measures, you will see 90° line representing the right angle. This is exactly vertical to the horizontal line. On both sides it is for measuring the two types of angle, clockwise angle and anticlockwise angle. These are inner scale and outer scale, both having 0° to 180° in two directions. (clockwise and anti clockwise). It is divided into 180 equal divisions and each division is called a degree (1°). These divisions on the curved edge are at a gap of 10°. A line joining the zeros (0°) on either side that passes through the centre point is a Base line.

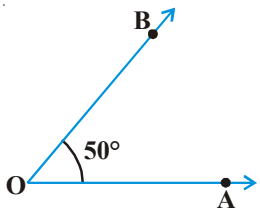
Now, you will learn how to use the protractor to measure an angle.

Clockwise Angle	Steps	Anti-clockwise Angle
	1. Identify the angle which is acute or obtuse. 2. Place the centre point of the protractor on the vertex of the angle. 3. Adjust the protractor (without shifting the centre point from the vertex) So that one arm of the angle is along the base line.	



4. Look at the scale where the base line points to 0°.

5. Read the measure of this angle, where the other arm crosses the scale thus ∠AOB = 50°

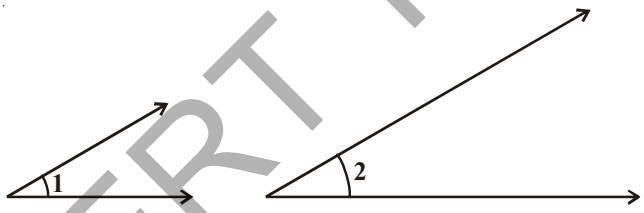


Read the table:

Type of Angle	Measure
Zero angle	0^0
Right angle	90^0
Straight angle	180^0
Complete angle	360^0
Acute angle	between 0^0 and 90^0
obtuse angle	between 90^0 and 180^0
Reflex angle	between 180^0 and 360^0

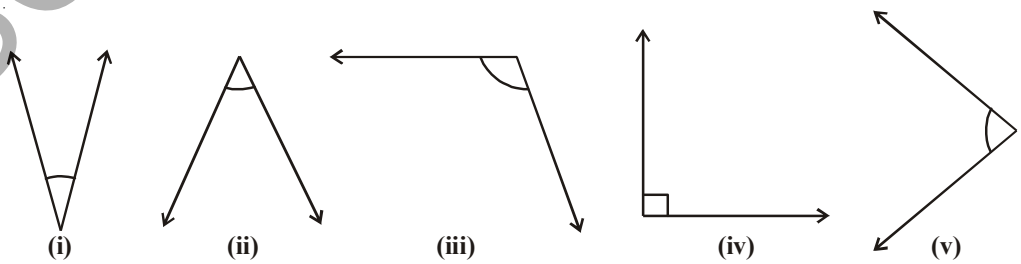
TRY THESE

1. Which angle is greater? Discuss with your friends.

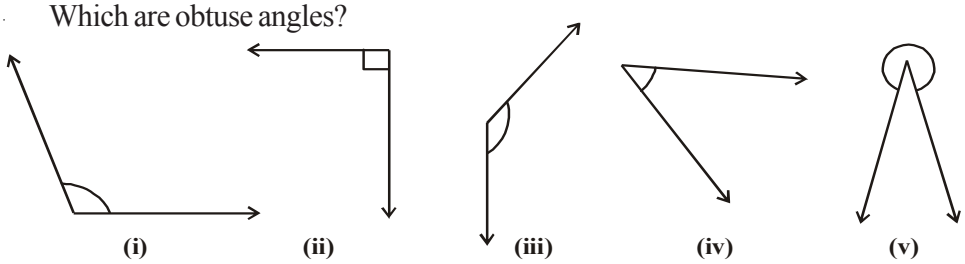


Verify by measuring the angles. Is your estimation is correct? Give reasons.

2. Which are acute angles? Find and write their measures.



3. Which are obtuse angles?



4. Draw any two acute and two obtuse angles of your choice.

5. Classify the following angles into acute, right, obtuse and straight angles:

40°, 140°, 90°, 210°, 44°, 215°, 345°, 125°,
10°, 120°, 89°, 270°, 30°, 115°, 180°

EXERCISE - 5.2

1. Write 'True' or 'False'. Correct all those that are false.

i. An angle smaller than right angle is acute angle ( )

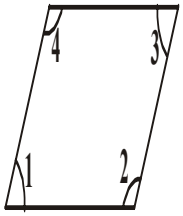
ii. A right angle measures 180° ( )

iii. A straight angle measures 90° ( )

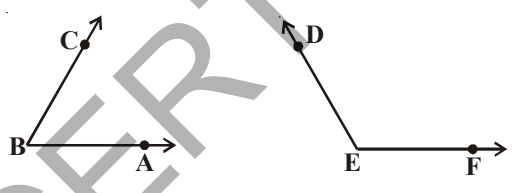
iv. The measure greater than 180° is a reflex angle. ( )

v. A complete angle measures 360°. ( )

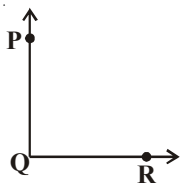
2. Which angles in the adjacent figure are acute and which are obtuse? Check your estimation by measuring them. Write their measures too.



3. What is the measure of these angles. Which is the largest angle? Draw an angle larger than the largest angle.



∠ABC = ... ∠FED = ...



∠RQP = ...

4. Write the type of angle formed between the long hand and short hand of a clock at the given timings. (Take the small hand as the base)

i. At 9 'O' clock in the morning.

ii. At 6 'O' clock in the evening

iii. At 12 noon

iv. At 4 'O' clock in the afternoon

v. At 8 'O' clock in the night.

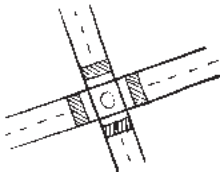
5. Match the angles by measure. Draw figures for these as well.

Group A	Group B
Acute angle	90°
Right angle	270°
Obtuse angle	45°
Reflex angle	180°
Straight angle	150°

5.4 Intersecting line, perpendicular lines and parallel lines

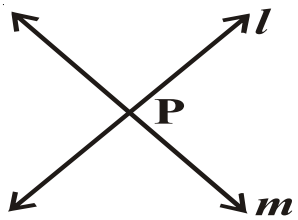
5.4.1 Intersecting lines

Look at the following pictures.



We can see that the roads and sticks can be represented by lines. The lines drawn in the pictures represent a pair of intersecting lines.

These lines have a common point. How many common points two distinct lines can have?



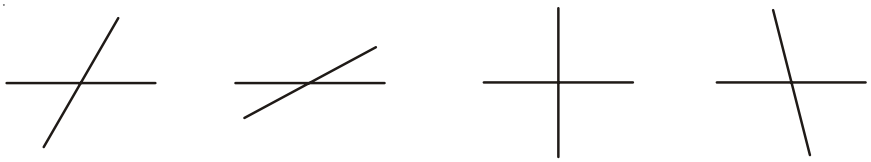
Try These

1. Draw any two separate lines in a plane. Do they intersect at more than one point?
2. Can you think of distinct lines that have three common points? Two common points?

Two separate lines l and m meet each other at a point P. We say l and m intersect at P. This is the only common point that these lines can have. **If two lines have a common point, they are called intersecting lines**.

Think about lines that have no common point what would these lines be like?

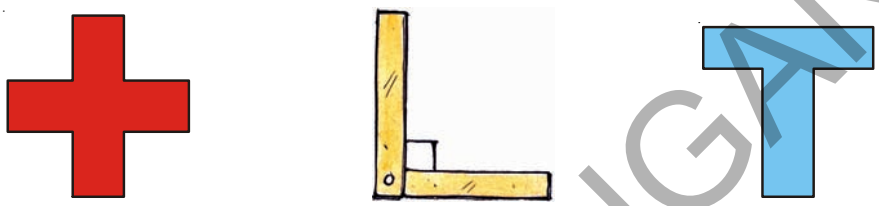
Angles are made by lines that intersect. Look at the intersecting lines below. They all form many angles. Identify all the angles formed by the intersecting lines.



Some of these angles are obtuse, some are acute and some are right angles.

5.4.2 Perpendicular lines:

Observe the lines formed between the edges of the Figures.

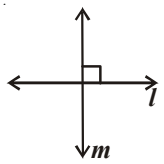


Imagine the lines in the Figures.

Do they make a right angles? Do they intersect each other?

If two lines intersect each other at right angle, then the lines are perpendicular.

Here a line 'l' is perpendicular to a line 'm' we write it as $l \perp m$.

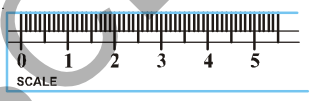


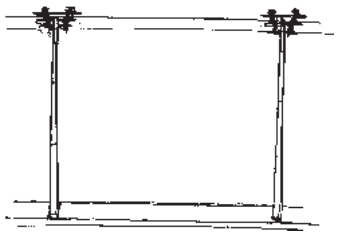
THINK, DISCUSS AND WRITE

1. If $l \perp m$, then can we say that $m \perp l$?
2. How many perpendicular lines can be draw to a given line?
3. Which letters in English alphabet possess perpendicularity?

5.4.3 Parallel lines

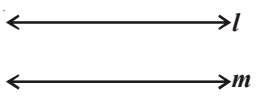
Observe the Figures:





Imagine the edges of scale, railway track, electrical wires. What is special in these pairs of lines? Would they meet if we extend them without changing direction.

If two lines on a plane do not intersect each other at any point, they are called parallel lines. Here l and m are parallel lines. We write it as $l \parallel m$ and read it as(l is parallel to m).

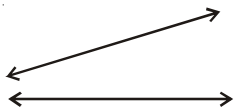


Can you find some more examples of parallel lines in the classroom?

TRY THESE

Draw two lines on a paper as shown below. Do they intersect each other? Can you call them parallel lines? Give reason.

Make a pair of parallel lines what is the angle formed between them? Think, discuss with your friends and teacher.



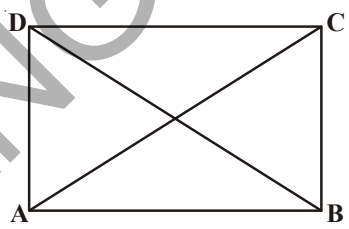
EXERCISE - 5.3

1. Which of the following are models for parallel lines, perpendicular lines and which are neither of them.

   i) The vertical window bars ii) Railway lines (track) iii)The adjacent edges of door. iv) The letter 'V' in English alphabet v)The opposite edges of Black Board.

2. Trace the copy of set squares (Geometry box) on a paper and mark the perpendicular edges.

3. ABCD is a rectangle. $\overline{AC}$ and $\overline{BD}$ are diagonals.



   Write the pairs of parallel lines, perpendicular lines and intersecting lines from the figure in symbolic form.

   a) Parallel lines b) Perpendicular lines c) Pair of intersecting lines

WHAT HAVE WE DISCUSSED?

1. We compare two line segments by simple observation, by tracing the segments and by using instruments.
2. The instruments used to compare and draw line segments are ruler and divider.
3. The unit of measuring length is 1 centimeter (1 cm)1 cm = 10 mm.
4. A protractor is a semi circular curved model with 180 equal divisions used to measure and construct angles.
5. The unit of measuring an angle is a degree (1°). It is $\frac{1}{360}^{th}$ part of one rotation.
6. The measure of right angle is 90° and that of straight angle is 180°.
7. An angle is **acute** if its measure is smaller than that of a right angle.
8. An angle is **obtuse** if its measure is more than that of a right angle and less than a straight angle.
9. An angle is **reflex** if its measure is more than a straight angle and less than a complete angle.
10. Two distinct lines of a plane which have a common point are **intersecting lines.**
11. Two intersecting lines are **perpendicular** if the angle between them is a right angle.
12. If two lines of a plane do not intersect each other then they are called parallel lines.
13. Two parallel lines do not have any common point.