Chapter–3

PARALLEL LINES

Parallel Lines

In your previous class, you have studied about parallel lines. These are two straight lines on the same plane, the perpendicular distance between them is always the same. Extended in both directions, these lines never cross or intersect each other.

The two opposite sides of a square or rectangle, the edges of a black board, the railway track etc. are examples of parallel lines. Think about some more such examples of parallel lines and write them in your notebook.

Distance between two parallel lines:

The perpendicular distance between two parallel lines is always the same. To know this, we draw a perpendicular from any point on one line to the other line. The length of the perpendicular thus obtained is distance between the two lines.

Activity 1.

Draw two parallel lines on your notebook. Measure the distance between these two lines at different point and complete the table below.

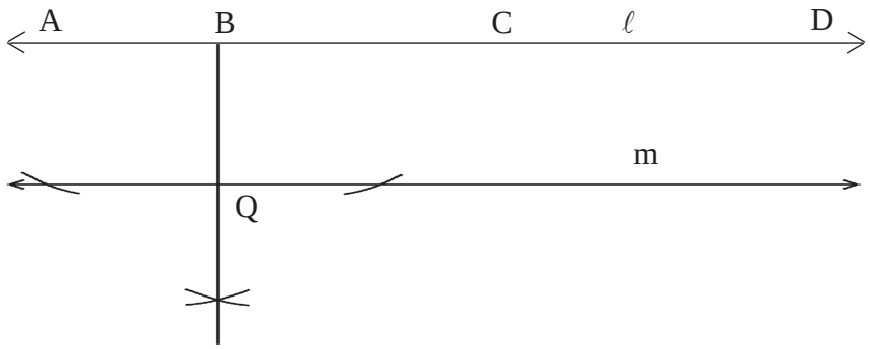


Table 3.1

S.No.	Points marked on line ℓ	Draw perpendicular from line to line making at point	Distance (in cm.)
1	A	.....	.....
2	B	Q.....	BQ =.....
3	C	.....	.....
4	D	.....	.....

Is the distance between the two lines are the same in all the cases?

.....

To draw a parallel line at a given distance with respect to a given line.

To draw a line m parallel to line ℓ at a distance of 3cm.

Steps of construction

1. Take any point P on the given line ℓ. (Fig 3.2)

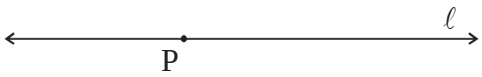


Fig 3.2

2. Draw a perpendicular PQ $\perp \ell$ (Fig 3.3) on point P.

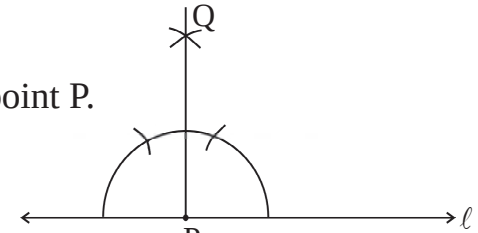


Fig 3.3

3. Taking point P as the centre, draw an arc of radius 3cm. on PQ which cuts PQ at R (Fig 3.4)

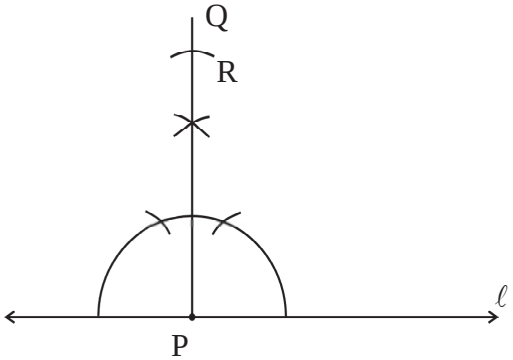


Fig 3.4

4. Draw RS⊥PR at point R and extend RS as line m . (Fig 3.5)

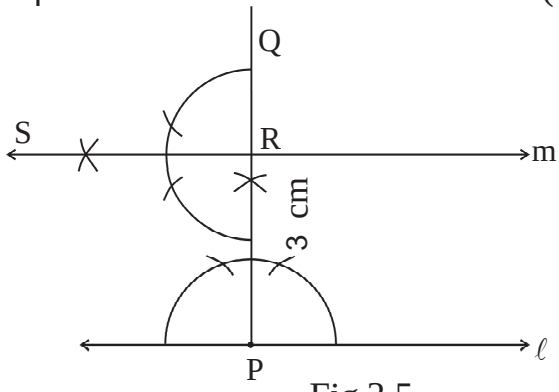


Fig 3.5

Thus line m, is a parallel line to ℓ at a distance of 3cm.

Note : Parallel lines at a given distance can be drawn with the help of set square also.

Some characteristic features of parallel lines

The perpendicular drawn at two points on the same line are parallel.

Activity 2.

Draw a line ℓ and take any two points A & B on it draw perpendicular AM from point A and Perpendicular BN from point B on line ℓ.

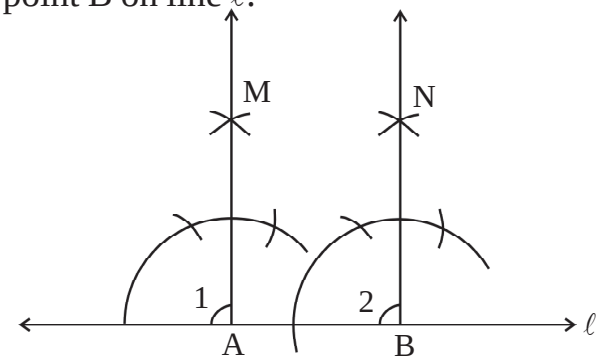


Fig 3.6

Ask your friends to draw two perpendicular on line in their notebooks and fill up the given table by measuring the adjacent angles in their figures.

Table 3.2

S.No	Name	∠1	∠2	Is ∠1 = ∠2 ?
1.	Mohan	------	------	----------
2.	----------	------	------	----------
3.	----------	------	------	----------
4.	----------	------	------	----------

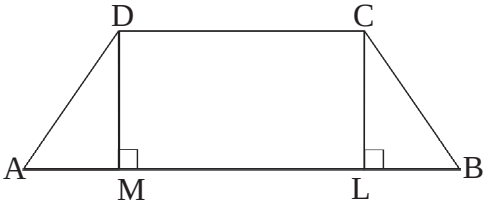
We see that in each situation , $\angle 1 = \angle 2$, since these are corresponding angles, therefore lines AM and BN are parallel lines. Thus on the same plane, the perpendiculars drawn on two points of a line are parallel to each other.

Practise - 1

1. Draw a line and construct a line parallel to it at a distance of 3 cm.

2. Draw a line and construct a line parallel to it at a distance of 4.3 cm. How may maximum number of lines like this can be drawn parallel to a line?

3. ABCD is a parallelogram where AB|| CD, CL⊥AB and DM⊥AB. Is CL||DM ? what kind of a quadrilateral is DMLC? What kind of triangles are ΔADM and ΔLCB.



Two lines parallel to a given line are parallel to each other.

Activity 3.

In the figures below m and n are lines parallel to line ℓ and ***t*** is an inclined line intersecting these lines. Now, measure the angle in the figures and complete the table that follows.

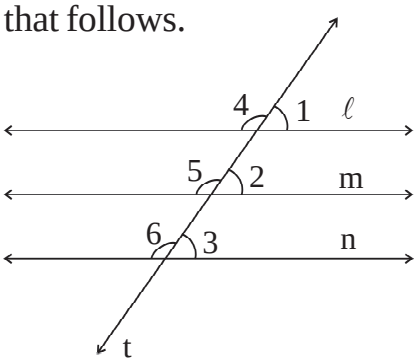


Fig 3.7

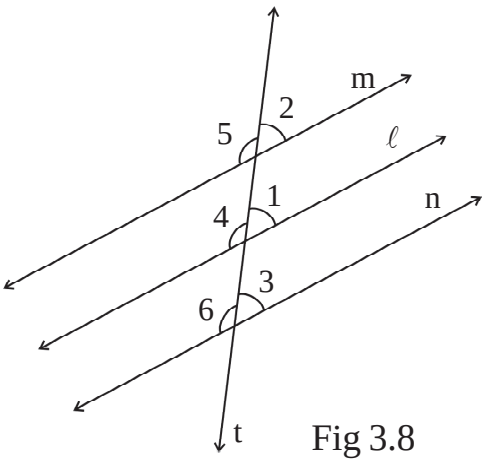


Fig 3.8

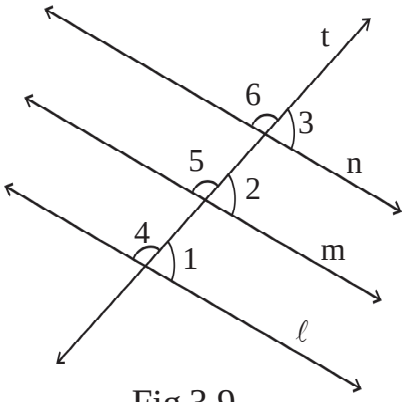


Fig 3.9

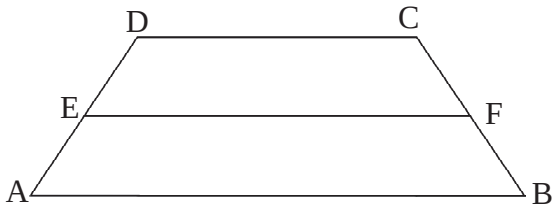
Table 3.3

Fig. No.	Measure of angles (in degree)							
	$\angle 1$	$\angle 2$	$\angle 3$	$\angle 4$	$\angle 5$	$\angle 6$	Is $\angle 2=\angle 3$?	Is $\angle 5=\angle 6$?
3.7								
3.8								
3.9								

In the figure, we can see that $\angle 2 = \angle 3$, and $\angle 5=\angle 6$, but these are corresponding angles. Therefore lines *m* and *n* are parallel to each other i.e. lines drawn parallel to a given line are all parallel to each other.

Practise - 2

1. In the figure ABCD is a trapezium. Where AB||DC segment EF||AB and E and F are points on AD and BC respectively. Is EF||DC, if yes then why?
2. How many trapezium are there in this figure? Name them.



Intercepts

When two straight lines are intersected by any inclined line, then the intersected part between the two straight lines is known as the intersecting segement. In the figure AB line ℓ & *m* are intersected by the line *n* and the intersected part AB is known as the intercept because it is inside the space between the two lines.

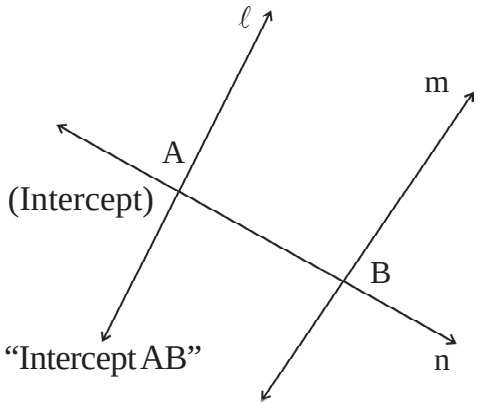


Fig 3.10

It is not necessary that the two lines ℓ & ***m*** are parallel to each other.

Practise - 3

1. In the given figures identity the intercepts and fill in the blanks.

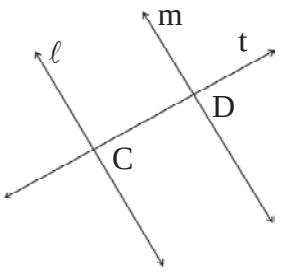


Fig 3.11

intercept ——————————

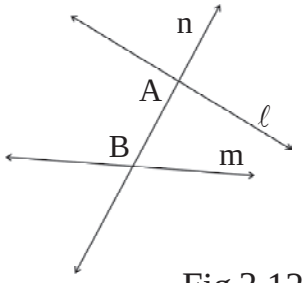


Fig 3.12

intercept ——————————

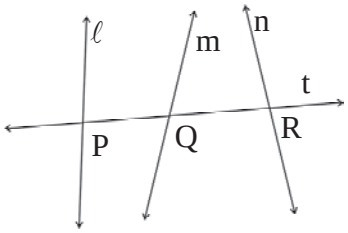


Fig 3.13

intercept ——————————

Parallel lines and equal intercepts

Activity 4.

In the given figures the line P contains there points A,B,C in a way that AB=BC. Three lines ℓ, m & n have been drawn passing through these three points intersecting there. Three lines are inclined by line *t* which intersect the lines ℓ, m, and n at points D, E and F respectively.

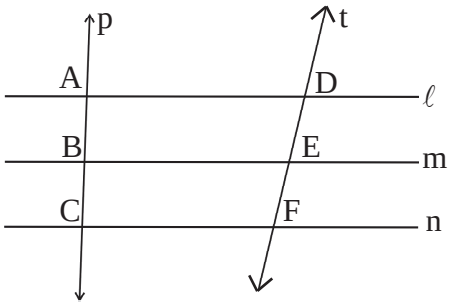


Fig 3.14

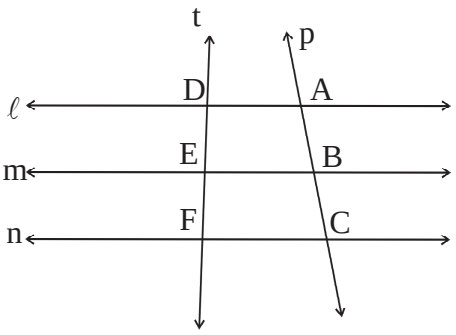


Fig 3.15

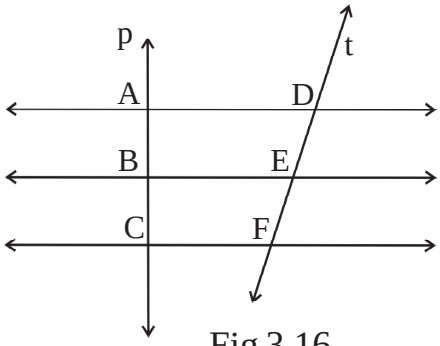


Fig 3.16

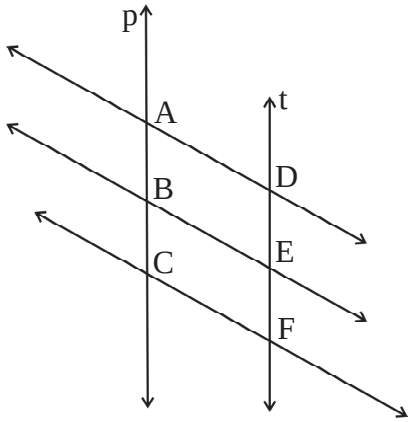


Fig 3.17

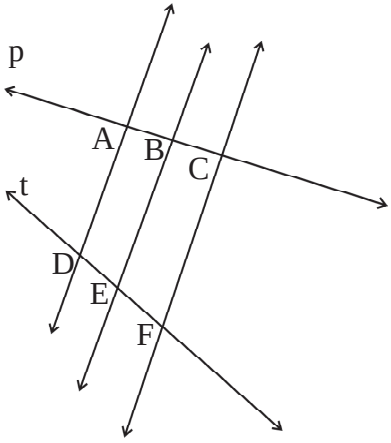


Fig 3.18

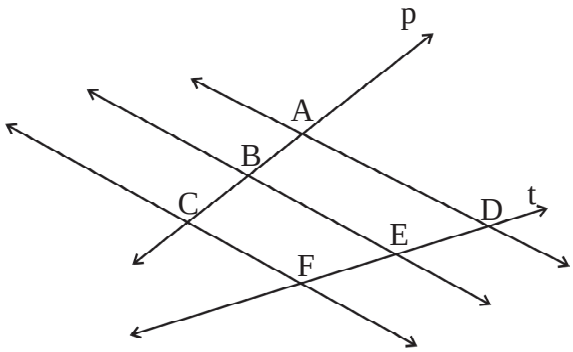


Fig 3.19

Table 3.4

S.No	DE	EF	Is DE = EF ?
3.14			
3.15			
3.16			
3.17			
3.18			
3.19			

In the above activity, you have seen that in every situation DE = EF.

Therefore, we can conclude that if a transversal line intersecting **"three parallel lines produces equal intercept then the other transversal will also produce equal intercept"**.

Activity 5.

In the given figures $\ell \parallel m \parallel n$ and the intersecting lines 's' and 't' crosses these parallel lines at A, B, C and D, E, F. Use scale to measure the sections given in the table and complete the information asked for.

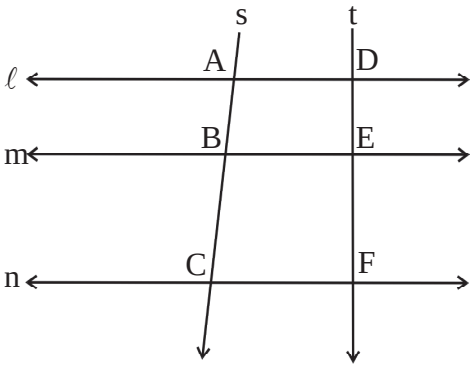


Fig 3.20

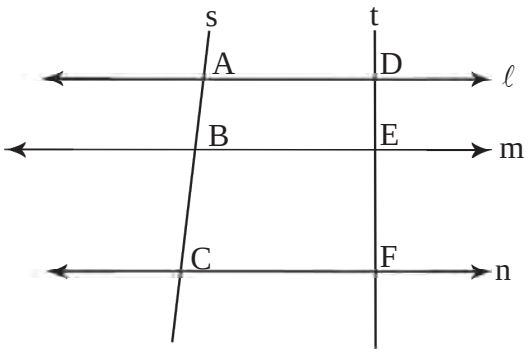


Fig 3.21

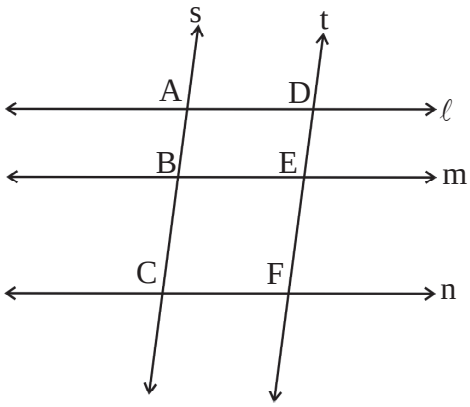


Fig 3.22

Table 3.5

S.No.	Fig. No.	**AB**	**BC**	$\frac{AB}{BC}$	**DE**	**EF**	$\frac{DE}{EF}$	Is $\frac{AB}{BC} = \frac{DE}{EF}$?
1.	3.20							
2.	3.21							
3.	3.22							

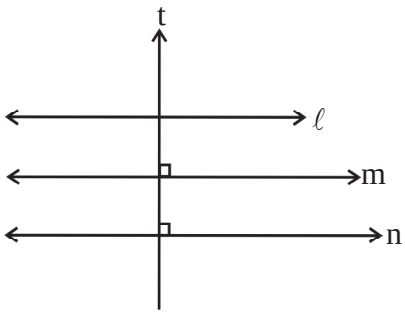
In the above activity in all the situations, we get $\frac{AB}{BC} = \frac{DE}{EF}$.

Therefore **if three parallel lines make equal intercepts on one transversal, then they make equal intercepts on any other transversal as well**.

EXERCISE - 3.1

1. Draw a line segment of 6 cm and taking any point P, draw a parallel line at a distance of 2.5cm .

2. In the given figure $\ell \parallel m$, $t \perp m$ and $t \perp n$, then

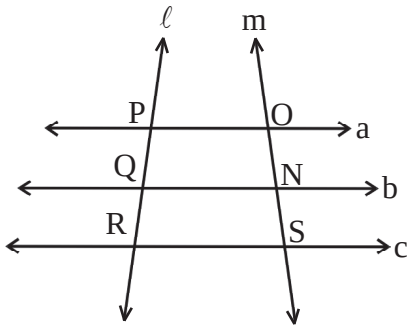


   (i) Is $m \parallel n$? Why?

   (ii) Is $\ell \parallel n$? Why?

   (iii) Is $t \perp \ell$? Why?

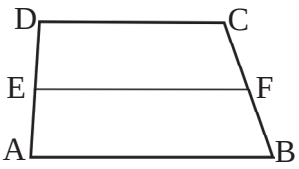
3. In the given figure $a \parallel b \parallel c$ and ℓ & m are two transversals. If PQ = QR, is ON= NS ? Why?



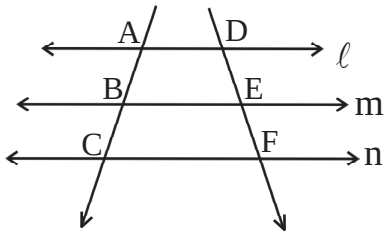
4. In the given figure AB|| DC, EF|| AB and E is the midpoint for the line segment AD, then

   (i) Is AB || EF || DC ? Why ?

   (ii) Is F, the midpoint for the line segment CB? Why?



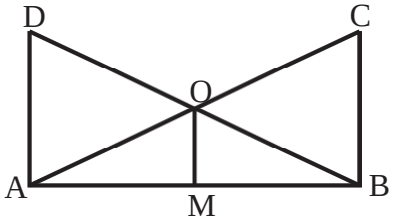
5. In the given figure $\ell \parallel m \parallel n$, will the ratio of the intercepts be equal ?



6. If line segments DA,CB and OM perpendicular on segment AB, where O is the intersecting points for line segments AC and DB, If OA =2.4 cm and OC =3.6 cm, then find out.

   (i) $\frac{AM}{BM}$

   (ii) If BO =3cm, find the value of DO.



Line drawn parallel to one side of a triangle

Activity 6.

In the given triangle ABC, DE|| BC that intersects AB on point D and AC on point E. with the help of the figures below measure the features asked for the table and complete it.

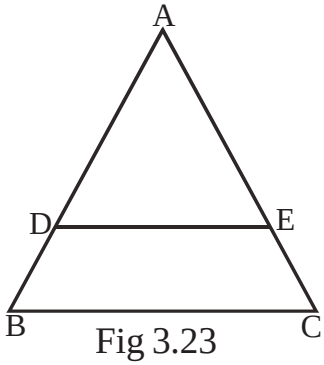


Fig 3.23

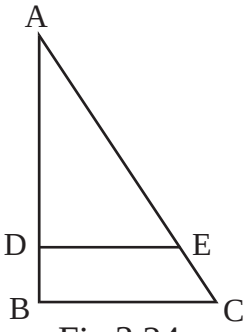


Fig 3.24

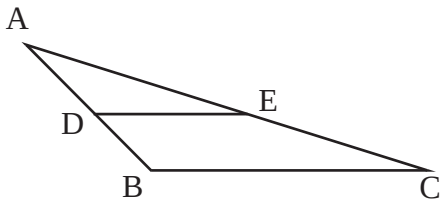


Fig 3.25

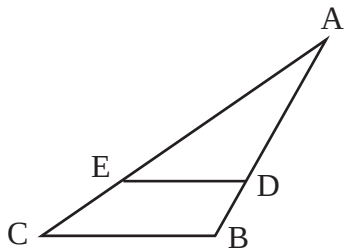


Fig 3.26

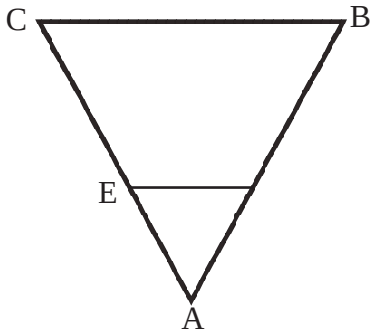


Fig 3.27

Table 3.6

S.No.	Fig. No	AD	DB	$\frac{AD}{DB}$	AE	EC	$\frac{AE}{EC}$	Is $\frac{AD}{DB}=\frac{AE}{EC}$?
1.	3.23							
2.	3.24							
3.	3.25							
4.	3.26							
5.	3.27							

In the above activity, every situation gives us sufficient proof for $\frac{AD}{DB}=\frac{AE}{EC}$.

Therefore a line drawn parallel to one side of a triangle divides the other two sides in equal ratio.

Relationship between the line joining the midpoint of two sides of a triangle & its third side.

Activity 7.

In the given triangles ΔABC, the midpoints of AB and AC are D and E respectively. Measure the angles formed on DE and at points B & C and complete the table below.

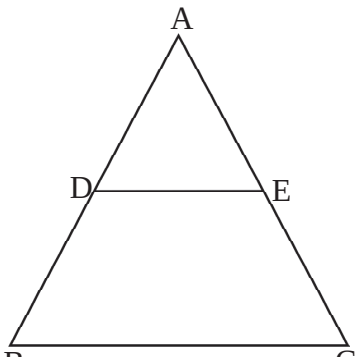


Fig 3.28

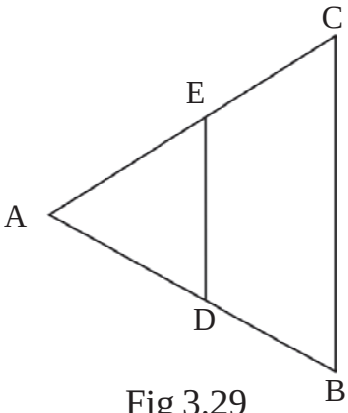


Fig 3.29

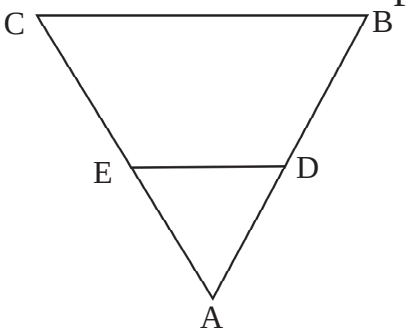


Fig 3.30

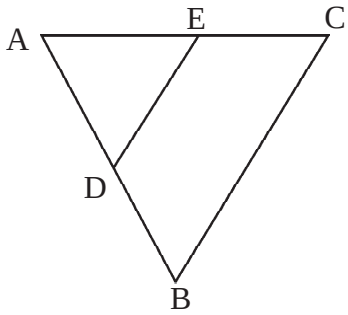


Fig 3.31

Table 3.7

S.No	Fig No	∠ADE	∠B	Is $\angle ADE = \angle B$?	∠AED	∠C	Is ∠AED = ∠C?
1.	3.28						
2.	3.29						
3.	3.30						
4.	3.31						

In the above activity you find that ∠ADE = ∠B and ∠AED = ∠C. Observe the angles carefully again ?What are the names of these angles?

When corresponding angles are equal, what is the relationship between the lines?

Therefore,

The line joining the midpoint of two sides of a triangle is parallel to its third side.

Division of a line segment into equal parts

Salma said to Ashok, “Can you divide a 5 cm. line into three equal parts?

Ashok said “ Why not?” He divided 5 by 3 and 5/3 =1.66 cm was obtained But when he started measure 1.66 cm on the scale, he could not do so, he took two divisions of 1.6 cm each and the third part that remained was 1.8 cm.

Salma said, oh it is not possible to divide a line segment into desired divisions with the help of a scale. They thought there must be some way to divide a line segment into as many parts as you like without measuring them.

Let’s find out how we can use parallel lines to divide a line segment into many equal parts without using a scale.

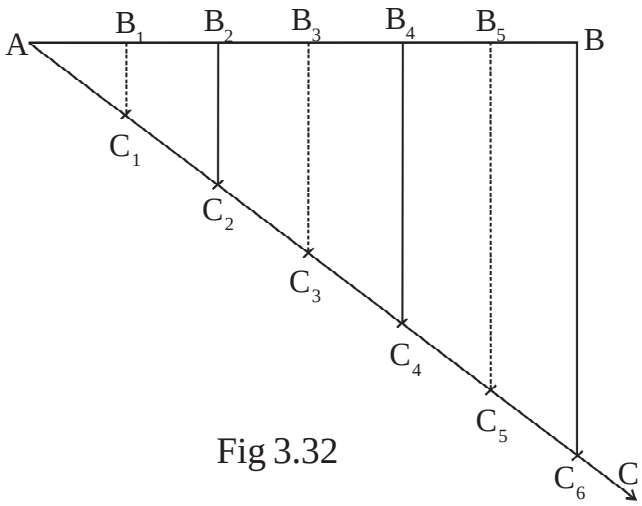


Fig 3.32

Example 1. To divide line segment AB into 6 equal parts.

Steps of the construction :

1. Draw a ray AC on point A of line segment AB, making an acute angle.

2. Now cut 6 equal parts from point A of ray AC as AC_1, C_1C_2, C_2C_3,...,C_5C_6 by using rounder.

3. Join C_6 and B and draw parallel lines in the reverse order C_5, C_4,....C_1 that meet at points $B_5B_4B_3...B_1$ on AB.

   Thus segment AB gets divided into 6 equal parts as AB_1, B_1B_2, B_2B_3,B_3B_4, B_4B_5,B_5B, that make the 6 equal parts.

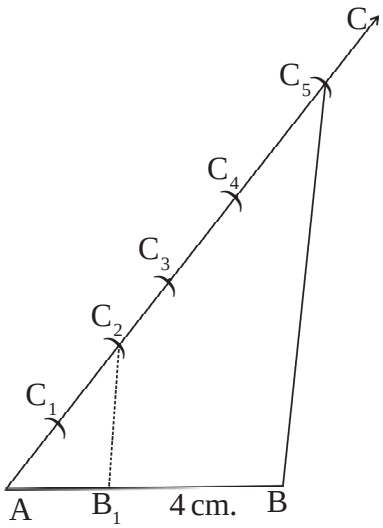


Fig 3.33

Example 2. Take a line segment of 4 cm and divide it in the ratio of 2:3 cm.

Steps of the construction :

1. Draw a line segment of 4cm. & then a ray AC that makes an acute angle on line AB.

2. Draw equidistance arcs AC_1, C_1C_2, ...C_4C_5 of the same radius on ray AC with the help of compass mark 5 equal parts in it that is the sum of the ratio (2+3=5)in cm.

3. Now join BC_5 and draw a line parallel to BC_5 at point C_2 that intersects line segments AB on B_1 Thus the line segments of desired ratio AB_1 and B_1B were obtained, which mean $AB_1 : B_1B = 2 : 3$

Thus taking different line segments of different measures and divide them in desired ratios and ask your friends to do the same.

Another method to divide a line into equal parts –

Harish was enjoying the division of segments but sometimes, he was facing problems in having the parallel lines. Let us look at another method of dividing a line segments into equal parts. This method is also very easy.

Example 3. Draw line segment AB and divide into four equal parts.

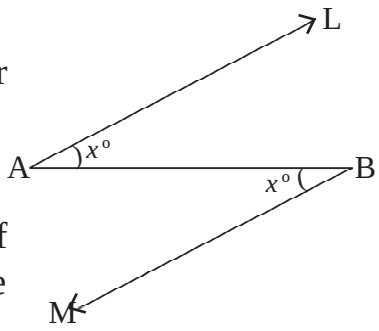


Fig 3.34

Construction 1. Draw a line AB and draw acute angles of equal measure at both its ends in the opposite directions.

Remember that the angles should be equal and acute.

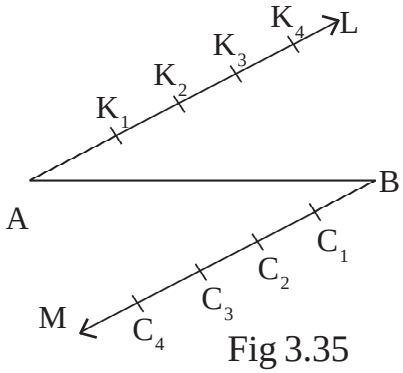


Fig 3.35

Construction 2. With the help of compass cut 4 - 4 arcs of equal radius on both the rays AL& BM .

Construction 3. Join the last point K_4 & C_4 to points B & A respectively.

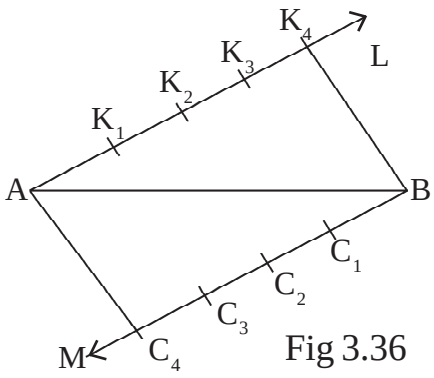


Fig 3.36

Construction 4. Now join K_3 to C_1 and K_2 to C_2 & K_1 to C_3 .

Thus we get Three points D_1, D_2, D_3 on AB which divides the segment into four parts equally.

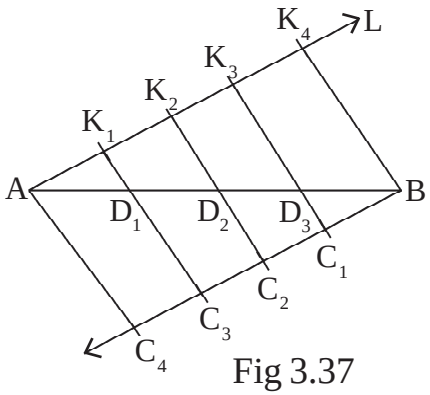
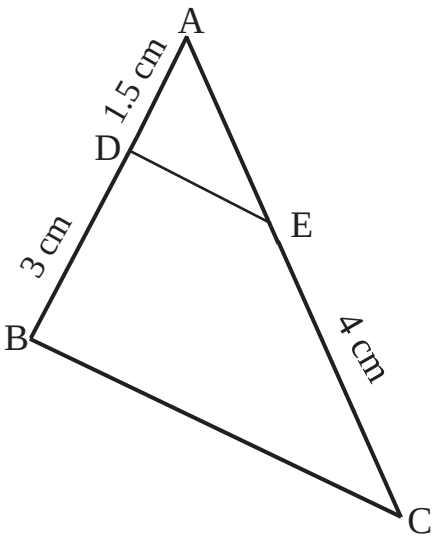


Fig 3.37

EXERCISE - 3.2

1. In the given figure DE|| BC, if AD=1.5 cm, DB= 3cm & EC =4 cm then find out the measure of AE.



2. Draw a line segment AB of 7.5 cm and divide it into 3 equal parts. Measure the length of each part.

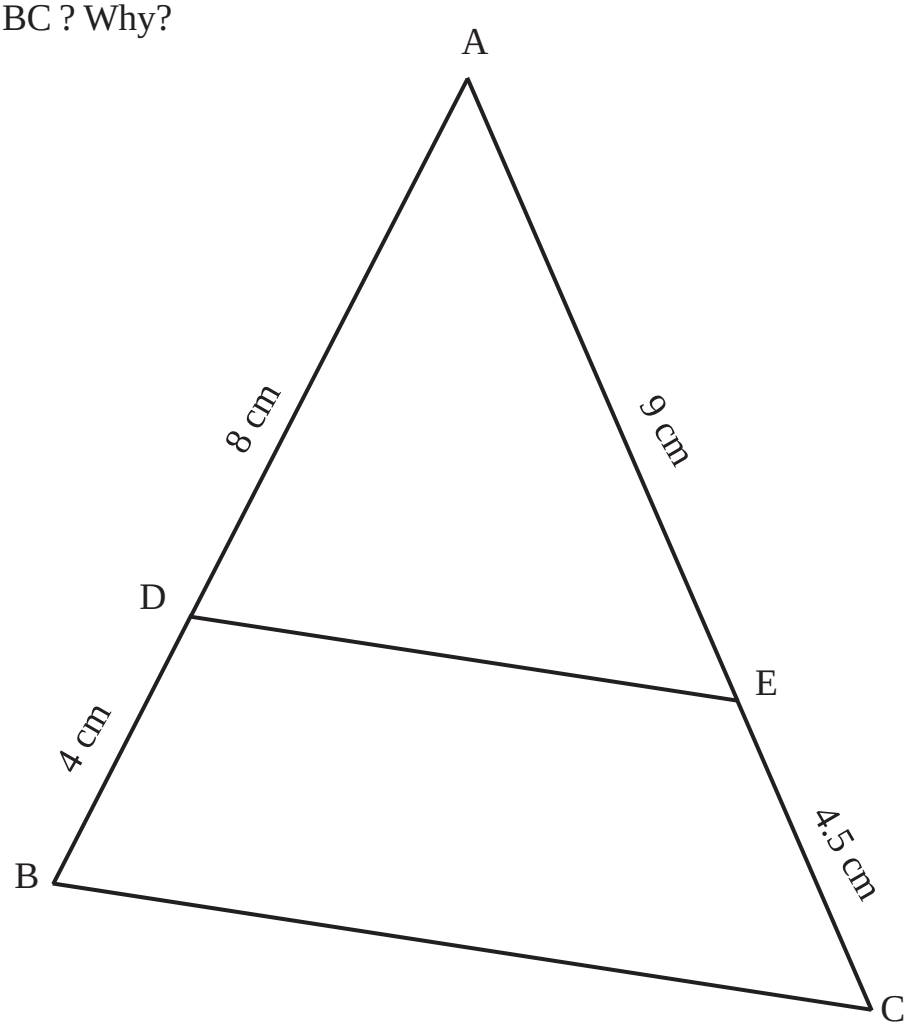
3. Draw a line segment of 8.4 cm & divide it into seven equal parts. Measure the length of each part.

4. Divide a line segment of 10 cm into ratio of 2:3.

5. Draw a line segment AB of 7cm. Find a point P on this in such a way that

$$AP = \frac{2}{5}AB.$$

6. In the given figure AD = 8cm BD=4 cm and AE =9cm EC=4.5 cm. Is DE|| BC ? Why?



WE HAVE LEARNT

1. The perpendicular distance between two parallel lines is always equal .
2. All the lines drawn parallel to a line are parallel to each other.
3. The Perpendicular drawn on different points on the same line are parallel to each other.
4. When a transversal line intersects three parallel lines to produce equal intercepts then other intersecting lines would also produce equal intercepts.
5. The ratio of intercepts on parallel lines by two intersecting lines are equal.
6. The line parallel to one side of a triangle divides the other sides in equal ratio.
7. The line joining the midpoints of the two sides of a triangle is parallel to its third side.