

Exercise 11.1

Q.1 One angle of a parallelogram is 130° . Find the measures of its remaining angles.

In parallelogram

$$m\angle B = 130^\circ$$

$$\angle D = \angle B$$

(Opposite angles of a parallelogram)

$$m\angle D = m\angle B = 130^\circ$$

We know that

$$\angle A + \angle B = 180$$

$$\angle A + 130 = 180$$

(sum of int. \angle s on same side of a parallelogram is 180°)

$$\angle A = 180 - 130$$

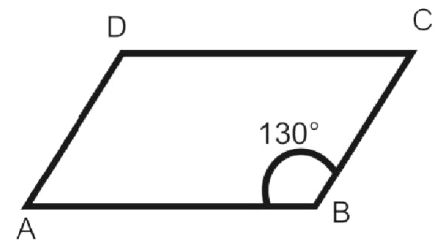
$$\angle A = 50^\circ$$

If $\angle D = \angle B$

Then

$$\angle C = \angle A$$

$$\angle C = 50^\circ$$



Q.2 One exterior angle formed on producing one side of a parallelogram is 40° . Find the measures of its interior angles.

$ABCD$ is a parallelogram. \overline{BA} is produced towards A .

$$m\angle DAM = 40^\circ$$

$$m\angle DAB = ?$$

$$m\angle D = ?$$

$$m\angle B = ?$$

$$m\angle C = ?$$

$$\angle DAM + \angle DAB = 180^\circ$$

$$40^\circ + \angle DAB = 180^\circ$$

$$\angle DAB = 180^\circ - 40^\circ$$

$$\angle DAB = 140^\circ$$

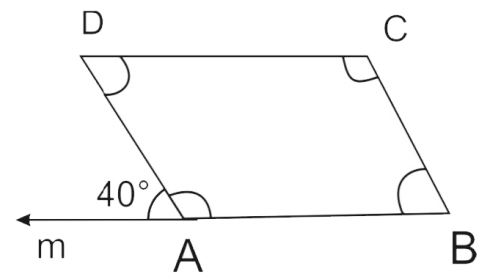
$$\angle DAB + \angle B = 180^\circ$$

$$140^\circ + \angle B = 180^\circ$$

$$\angle B = 180^\circ - 140^\circ$$

$$\angle B = 40^\circ$$

$$\angle D = \angle B = 40^\circ$$



$$\angle D = 40^\circ$$

$$\angle C = \angle DAB$$

$$\angle C = 140^\circ$$

Theorem 11.1.2

Statement: If two opposite sides of quadrilateral are congruent and parallel, it is a parallelogram

Given

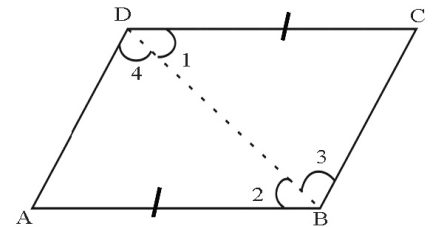
In quadrilateral $ABCD$,
 $\overline{AB} \cong \overline{DC}$ and $\overline{AB} \parallel \overline{DC}$

To prove

$ABCD$ is a parallelogram

Construction

Join the point B to D and in the figure name the angles as



Proof

Statements	Reasons
In $\triangle ABD \leftrightarrow \triangle CDB$	
$\overline{AB} \cong \overline{DC}$	Given
$\angle 2 \cong \angle 1$	Alternate angles
$\overline{BD} \cong \overline{BD}$	Common
$\therefore \triangle ABD \cong \triangle CDB$	SAS postulate
Now $\angle 4 \cong \angle 3$(i)	(Corresponding angles of congruent triangles)
$\therefore \overline{AD} \parallel \overline{BC}$(ii)	from (i)
and $\overline{AD} = \overline{BC}$(iii)	corresponding of sides of congruent triangles
Also $\overline{AB} \parallel \overline{DC}$(iv)	Given
Hence $ABCD$ is a parallelogram	From (ii)-(iv)

Exercise 11.2

- Q.1 Prove that a quadrilateral is a parallelogram if its**
(a) Opposite angles are congruent
(b) Diagonals bisect each other

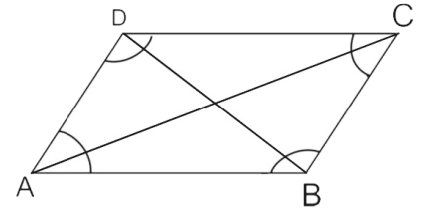
(a) Given

In quadrilateral ABCD

$$m\angle A = m\angle C, m\angle B = m\angle D$$

To Prove

ABCD is a parallelogram



Statements	Reasons
$m\angle A = m\angle C \dots (i)$	Given
$m\angle B = m\angle D \dots (ii)$	Given
$m\angle A + m\angle B + m\angle C + m\angle D = 360^\circ$	Angles of quadrilateral
$m\angle A + m\angle B = 180^\circ$	
$m\angle C + m\angle D = 180^\circ$	
$\overline{AD} \parallel \overline{BC}$	
Similarly it can be proved that $\overline{AB} \parallel \overline{DC}$	
Hence ABCD is a parallelogram	

(b) Given

In quadrilateral ABCD, diagonals \overline{AC} and \overline{BD} bisect each other.

i.e. $\overline{OA} = \overline{OC}, \overline{OB} = \overline{OD}$

To prove ABCD is a parallelogram

Proof

Statements	Reasons
In $\triangle ABO \leftrightarrow \triangle CDO$	
$\overline{OA} \cong \overline{OC}$	Given
$\overline{OB} \cong \overline{OD}$	Given
$\angle AOB \cong \angle COD$	Vertical opposite angles
$\therefore \angle 1 \cong \angle 2$	Corresponding angles of congruent triangles
$\triangle ABO \cong \triangle CDO$	$S.A.S \cong S.A.S$
Hence, $\overline{AB} \parallel \overline{CD} \dots (i)$	$\angle 1 \cong \angle 2$
By taking BOC and is $\triangle AOD$ it can be prove that	
$\overline{AD} \parallel \overline{BC} \dots (ii)$	From (i) and (ii)
Hence ABCD is a parallelogram	

Q.2 Prove that a quadrilateral is a parallelogram if its opposite sides are congruent

Given

In quadrilateral $ABCD$

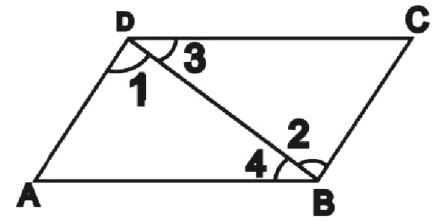
(i) $\overline{AB} \cong \overline{DC}$

(ii) $\overline{AD} \cong \overline{BC}$

To prove

$ABCD$ is a parallelogram i.e. $\overline{AD} \parallel \overline{BC}$

Prove



Statements	Reasons
$\triangle CDB \leftrightarrow \triangle ABD$	
$\overline{AB} \cong \overline{DC}$	Given
$\overline{AD} \cong \overline{BC}$	Given
$\overline{BD} \cong \overline{BD}$	Common
$\triangle ABD \cong \triangle CDB$	$S.S.S \cong S.S.S$
Thus, $\angle 1 \cong \angle 2$	Corresponding angles of congruent triangles
$\angle 4 \cong \angle 3$	Corresponding angles of congruent triangles
(i) $\overline{AD} \parallel \overline{BC}$	Alternate angles are congruent
$\overline{AB} \parallel \overline{DC}$	Alternate angles are congruent
$\therefore ABCD$ is a parallelogram	

Example

The line segments, joining the mid-points of the sides of a quadrilateral, taken in order, form a parallelogram.

Given

A quadrilateral $ABCD$, in which P is the mid-point of

\overline{AB} Q is the mid-point of \overline{BC} R is the mid-point of \overline{CD}

S is the mid-point of \overline{DA}

P is joined to Q , Q is joined to R .

R is joined to S and S is joined to P .

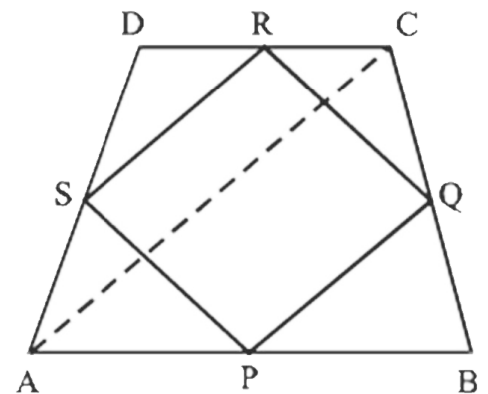
To prove

$PQRS$ is a parallelogram.

Construction

Join A to C .

Proof



Statements	Reasons
In $\triangle DAC$,	
$\overline{SR} \parallel \overline{AC}$	S is the midpoint of \overline{DA}
$m\overline{SR} = \frac{1}{2}m\overline{AC}$	R is the midpoint of \overline{CD}

<p>In $\triangle BAC$,</p> $\left. \begin{array}{l} \overline{PQ} \parallel \overline{AC} \\ m\overline{PQ} = \frac{1}{2} m\overline{AC} \end{array} \right\}$ <p>$\overline{SR} \parallel \overline{PQ}$</p> <p>$m\overline{SR} = m\overline{PQ}$</p> <p>Thus $PQRS$ is a parallelogram</p>	<p>P is the midpoint of \overline{AB}</p> <p>Q is the midpoint of \overline{BC}</p> <p>Each $\parallel \overline{AC}$</p> <p>Each $= \frac{1}{2} \overline{AC}$</p> <p>$\overline{SR} \parallel \overline{PQ}, m\overline{SR} = m\overline{PQ}$ (proved)</p>
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Theorem 11.1.3

The line segment, joining the midpoint of two sides of triangle, is parallel to the third side and is equal to one half of its length.

Given

In $\triangle ABC$, the mid-point of \overline{AB} and \overline{AC} are L and M respectively

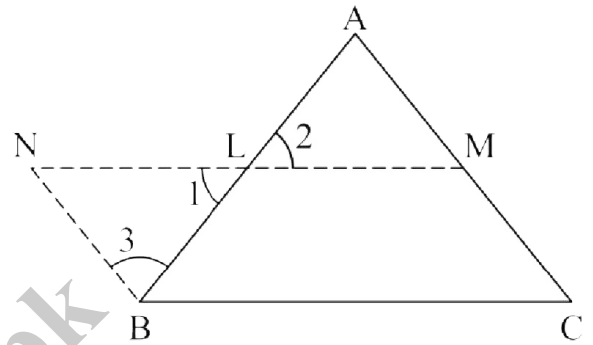
To prove

$\overline{LM} \parallel \overline{BC}$ and $m\overline{LM} = \frac{1}{2} m\overline{BC}$

Construction

Join M to L and produce \overline{ML} to N such that $\overline{ML} \cong \overline{LN}$

Join N to B and in the figure, name the angles $\angle 1, \angle 2$ and $\angle 3$ as shown.



Proof

Statements	Reasons
In $\triangle BLN \leftrightarrow \triangle ALM$	
$\overline{BL} \cong \overline{AL}$	Given
$\angle 1 \cong \angle 2$	Vertical angles
$\overline{NL} \cong \overline{ML}$	Construction
$\therefore \triangle BLN \cong \triangle ALM$	S.A.S postulate
$\therefore \angle A \cong \angle 3 \dots (i)$	(Corresponding angles of congruent triangles)
And $\overline{NB} \cong \overline{AM} \dots (ii)$	(Corresponding sides of congruent triangles)
But $\overline{NB} \parallel \overline{AM}$	from (i), alternative $\angle s$
Thus	
$\overline{NB} \parallel \overline{MC} \dots \dots \dots (iii)$	(M is a point of \overline{AC})

$\overline{MC} \cong \overline{AM} \dots\dots\dots(\text{iv})$ $\overline{NB} \cong \overline{MC} \dots\dots\dots(\text{v})$ $BCMN$ is a parallelogram $\therefore \overline{BC} \parallel \overline{LM} \text{ or } \overline{BC} \parallel \overline{NL}$ $\overline{BC} \cong \overline{NM} \dots\dots\dots(\text{vi})$ $m\overline{LM} = \frac{1}{2}m\overline{NM} \dots\dots\dots(\text{vii})$ Hence, $m\overline{LM} = \frac{1}{2}m\overline{BC}$	Given from (ii) and (iv) From (iii) and (v) (Opposite sides of a parallelogram BCMN) (Opposite sides of a parallelogram) Construction. from (vi) and (vii)
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Exercise 11.3

Q.1 Prove that the line segments joining the midpoint of the opposite side of a quadrilateral bisect each other.

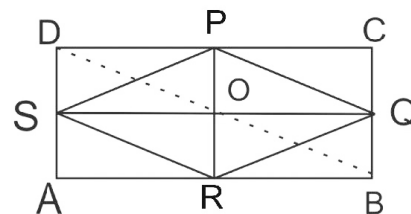
Given

$ABCD$ is quadrilaterals point $QRSP$ are the mid point of the sides \overline{RP} and \overline{SQ} are joined they meet at O .

$$\overline{OP} \cong \overline{OR} \quad \overline{OQ} \cong \overline{OS}$$

Construction

Join P, Q, R and S in order join C to A or A to C



Proof

Statements	Reasons
$SP \parallel AC \dots$ (i)	In $\triangle ADC$, S, P are mid point of AD, DC
$m\overline{SP} = \frac{1}{2}m\overline{AC} \dots$ (ii)	
$\overline{AC} \parallel \overline{RQ} \dots$ (iii)	In $\triangle ABC$, Q, R are midpoint of $\overline{BC}, \overline{AB}$
$m\overline{RQ} = \frac{1}{2}m\overline{AC} \dots$ (iv)	
$m\overline{SP} \parallel \overline{RQ} \dots$ (v)	
and $\overline{RQ} = \overline{SP} \dots$ (vi)	From (ii) and (iv)
Now \overline{RP} and \overline{SQ} diagonals of parallelogram $PQRS$ intersect at O .	
$\therefore \overline{OP} \cong \overline{OR}$	Diagonals of a parallelogram bisect each other.
$\overline{OS} \cong \overline{OQ}$	

Q.2 Prove that the line segments joining the midpoint of the opposite sides of a rectangle are the right bisectors of each other.

[Hint: Diagonals of a rectangle are congruent]

Given

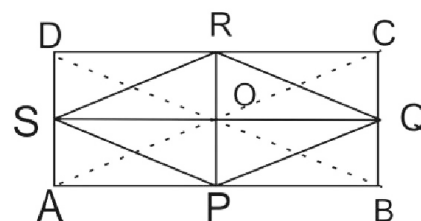
(i) $ABCD$ is a rectangle

(ii) P, Q, R, S are the midpoints of $\overline{AB}, \overline{CD}$ and \overline{DA}

(iii) \overline{SQ} and \overline{RP} cut each other at point O

$$\overline{OS} \cong \overline{OQ}$$

$$\overline{OP} \cong \overline{OR}$$



ConstructionJoin P to Q and Q to R and R to S and S to P Join A to C and B to D **Proof**

Statements	Reasons
Midpoint of \overline{BC} is Q	Given
Midpoint of \overline{AB} is P	Given
$\therefore \overline{AC} \parallel \overline{PQ}$(i)	
$\frac{1}{2}\overline{AC} = \overline{PQ}$(ii)	
In $\triangle ADC$	
$\overline{AC} \parallel \overline{SR}$(iii)	
$\frac{1}{2}\overline{AC} = \overline{SR}$(iv)	
$\overline{PQ} = \overline{SR}$	From equation (i) and (ii) each are parallel to \overline{AC} each are half of \overline{DB}
$\overline{SP} = \overline{RQ}$	
By joined B to D we can prove	
$\overline{RQ} \parallel \overline{SP}$	
$m\overline{SR} \parallel m\overline{PQ}$	
$m\overline{AC} \parallel m\overline{BD}$	Each of them = $\frac{1}{2}\overline{AC}$
PQRS is a parallelogram all it sides are equal	
$\overline{OP} \cong \overline{OR}$	
$\overline{OS} \cong \overline{OQ}$	
$\triangle OQR \leftrightarrow \triangle OQP$	
$\overline{OR} \cong \overline{OP}$	Proved
$\overline{OQ} \cong \overline{OQ}$	Common
$\overline{RQ} \cong \overline{PQ}$	Adjacent
$\therefore \triangle OQR \cong \triangle OQP$	
$\angle ROQ \cong \angle POQ$(vii)	
$\angle ROQ + \angle POQ = 180$(viii)	Supplementary angle
$\angle ROQ = \angle POQ = 90^\circ$	From (vii) and (viii)
Thus $\overline{PR} \perp \overline{QS}$	

Q.3 Prove that line segment passing the midpoint of one side and parallel to other side of a triangle also bisects the third side.

Given

In $\triangle ABC$, R is the midpoint of \overline{AB} , $\overline{RQ} \parallel \overline{BC}$

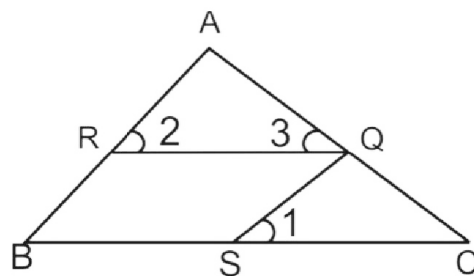
$$\overline{RQ} \parallel \overline{BS}$$

To prove

$$\overline{AQ} = \overline{QC}$$

Construction

$$\overline{QS} \parallel \overline{AB}$$



Proof

Statements	Reasons
$\overline{RQ} \parallel \overline{BS}$	Given
$\overline{QS} \parallel \overline{BR}$	Construction
$RBSQ$ is a Parallelogram	
$\overline{QS} \cong \overline{BR} \dots (i)$	Opposite side
$\overline{AR} \cong \overline{RB} \dots (ii)$	Given
$\overline{QS} \cong \overline{AR} \dots (iii)$	From (i) and (ii)
$\angle 1 \cong \angle B$ and $\angle 1 \cong \angle 2 \dots (iv)$	
$\triangle ARQ \leftrightarrow \triangle QSC$	
$\angle 2 \cong \angle 1$	From (iv)
$\angle 3 \cong \angle C$	
$\overline{AR} \cong \overline{SQ}$	From (iii)
Hence, $\triangle ARQ \cong \triangle QSC$	$A.A.S \cong A.A.S$
$\overline{AQ} \cong \overline{QC}$	Corresponding sides

Theorem: 11.1.4

Statement: The median of triangle are concurrent and their point of concurrency is the point of trisection of each median.

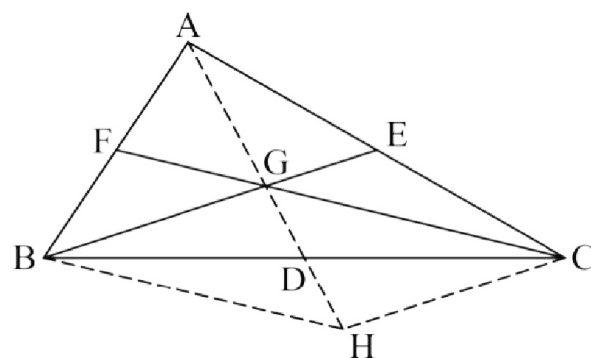
Given $\triangle ABC$

To prove

The medians of the $\triangle ABC$ are concurrent and the point of concurrency is the point of trisection of each median

Construction

Draw two medians \overline{BE} and \overline{CF} of the $\triangle ABC$ which intersect each other at point G . Join A to G and produce it to the point H such that $AG \cong \overline{GH}$. Join H to the points B and C . \overline{AH} intersects \overline{BC} at the point D .



Proof

Statements	Reasons
In $\triangle ACH$,	
$\overline{GE} \parallel \overline{HC}$	G and E are mid-points of sides \overline{AH} and \overline{AC} respectively
Or $\overline{BE} \parallel \overline{HC}$(i)	G is point of \overline{BE} diagonals \overline{BC}
Similarly $\overline{CF} \parallel \overline{HB}$...(ii)	
\therefore $BHCG$ is a parallelogram	From (i) and (ii)
And	
$m\overline{GD} = \frac{1}{2}m\overline{GH}$...(iii)	Diagonals \overline{BC} and \overline{GH} of a parallelogram $BHCG$ intersect each other at point D .
$\overline{BD} = \overline{CD}$	
\overline{AD} is a median of $\triangle ABC$ medians	
\overline{AD} , \overline{BE} and \overline{CF} pass through the point G	G is the interesting point of \overline{BE} , \overline{CF} and \overline{AD} pass through it.
Now $\overline{GH} \cong \overline{AG}$...(iv)	Construction
$m\overline{GD} = \frac{1}{2}m\overline{AG}$	From (iii) and (iv)
and G is the point of trisection of \overline{AD} ...(v)	
similarly it can be proved that G is also the point of trisection of \overline{CF} and \overline{BE}	

Exercise 11.4

Q.1 The distance of the point of concurrency of the medians of a triangle from its vertices are respectively 1.2 cm, 1.4 cm and 1.6 cm. Find the length of its medians.

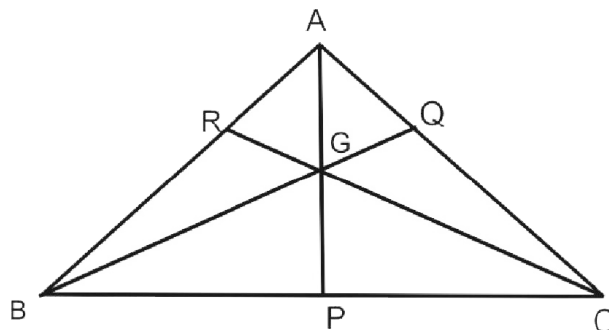
Let $\triangle ABC$ with the point of concurrency of medians at G

$$\overline{AG} = 1.2\text{cm}, \overline{BG} = 1.4\text{cm} \text{ and } \overline{CG} = 1.6\text{cm}$$

$$\overline{AP} = \frac{3}{2} \overline{AG} = \frac{3}{2} \times 1.2 = 1.8\text{cm}$$

$$\overline{BQ} = \frac{3}{2} \overline{BG} = \frac{3}{2} \times 1.4 = 2.1\text{cm}$$

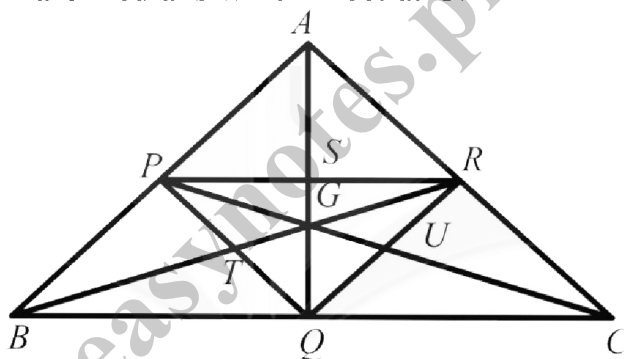
$$\overline{CR} = \frac{3}{2} \overline{CG} = \frac{3}{2} \times 1.6 = 2.4\text{cm}$$



Q.2 Prove that the point of concurrency of the medians of a triangle and the triangle which is made by joining the midpoint of its sides to the same.

Given

In $\triangle ABC$, AQ , CP , BR are medians which meet at G .



To prove

G is the point of concurrency of the medians of $\triangle ABC$ and $\triangle PQR$

Proof

Statements	Reasons
$\overline{PR} \parallel \overline{BC}$	P, R are midpoint of $\overline{AB}, \overline{AC}$
$\overline{BQ} \parallel \overline{PR}$	
Similarly $\overline{QR} \parallel \overline{BP}$	
$\therefore PBQR$ is a parallelogram its diagonals \overline{BR} and \overline{PQ} bisector each other at T	
Similarly U is the midpoint of QR and S is midpoint of \overline{PR}	
$\therefore \overline{PU}, \overline{QS}, \overline{RT}$ are medians of $\triangle PQR$	
(i) \overline{AQ} and \overline{SQ} pass through G	
(ii) \overline{BR} and \overline{TR} pass through G	
(iii) \overline{UP} and \overline{CP} pass through G	
Hence G is point of concurrency of medians of $\triangle PQR$ and $\triangle ABC$	

Example

A line, through the mid-point of one side, parallel to another side of a triangle, bisects the third side.

Given

In $\triangle ABC$, D is the mid-point of \overline{AB} .

$\overline{DE} \parallel \overline{BC}$ which cuts \overline{AC} at E .

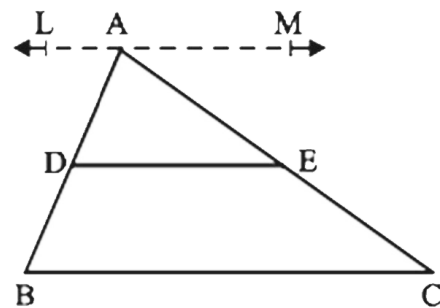
To prove

$\overline{AE} \cong \overline{EC}$

Construction

Through A , draw $\overline{LM} \parallel \overline{BC}$.

Proof



Statements	Reasons
Intercepts cut by $\overline{LM}, \overline{DE}, \overline{BC}$ on \overline{AC} are congruent. i.e., $\overline{AE} \cong \overline{EC}$.	$\left\{ \begin{array}{l} \text{Intercepts cut by parallels } \overline{LM}, \overline{DE}, \\ \overline{BC} \text{ on } \overline{AC} \text{ are congruent (given)} \end{array} \right.$

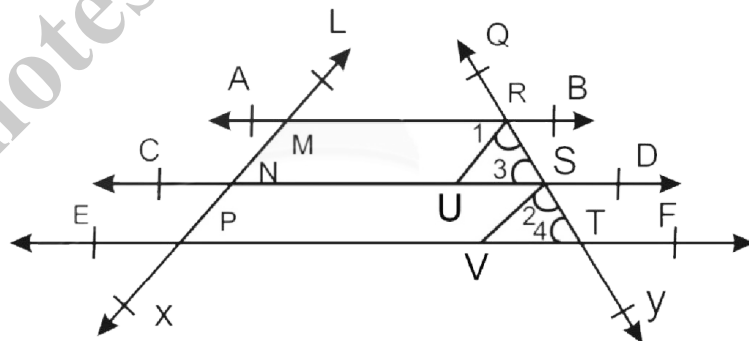
Theorem 11.1.5

Statement: In three or more parallel lines make congruent segments on a transversal they also intercept congruent segments on any other line that cuts them.

Given

$\overline{AB} \parallel \overline{CD} \parallel \overline{EF}$

The transversal \overline{LX} intersects $\overline{AB}, \overline{CD}$ and \overline{EF} at the points M, N and P respectively, such that $\overline{MN} \cong \overline{NP}$. The transversal \overline{QY} intersects them at point R, S and T respectively.



Prove

$\overline{RS} \cong \overline{ST}$

Construction

From R , draw $\overline{RU} \parallel \overline{LX}$, which meets \overline{CD} at U , from S draw $\overline{SV} \parallel \overline{LX}$ which meets \overline{EF} at V . as shown in the figure let the angles be labeled as $\angle 1, \angle 2, \angle 3$ and $\angle 4$.

Proof

Statements	Reasons
$MNUR$ is parallelogram	$\overline{RU} \parallel \overline{LX}$ (Construction) $\overline{AB} \parallel \overline{CD}$ (given)
$\therefore \overline{MN} \cong \overline{RU}$ (i)	(Opposite side of parallelogram).
Similarly.	
$\overline{NP} \cong \overline{SV}$ (ii)	
But $\overline{MN} \cong \overline{NP}$ (iii)	Given
$\therefore \overline{RU} \cong \overline{SV}$	{from (i) (ii) and (iii)} each is $\parallel \overline{LX}$ (construction)

Also $\overline{RU} \parallel \overline{SV}$

$\therefore \angle 1 \cong \angle 2$

and $\angle 3 \cong \angle 4$

In $\triangle RUS \leftrightarrow \triangle SVT$

$\overline{RU} \cong \overline{SV}$

$\angle 1 \cong \angle 2$

$\angle 3 \cong \angle 4$

$\therefore \triangle RUS \cong \triangle SVT$

Hence $\overline{RS} \cong \overline{ST}$

Corresponding angles

Corresponding angles

Proved

Proved

Proved

$S.A.A \cong S.A.A$

(Corresponding sides of congruent triangles)

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Exercise 11.5

Q.1 In the given figure

$\overline{AX} \parallel \overline{BY} \parallel \overline{CZ} \parallel \overline{DU} \parallel \overline{EV}$ and $\overline{AB} = \overline{BC} = \overline{CD} = \overline{DE}$

If $\overline{MN} = 1\text{cm}$ then find the length of \overline{LN} and \overline{LQ}

$\therefore \overline{PQ} \cong \overline{NP} \cong \overline{MN} \cong \overline{LM}$

$\overline{MN} = 1\text{cm}$

Given

$\overline{AP} \cong \overline{PQ} \cong \overline{QR} \cong \overline{RS} \cong \overline{ST}$

Therefore, $\overline{LN} = \overline{LM} + \overline{MN}$

$\overline{LM} = \overline{MN}$

so, $\overline{LN} = \overline{MN} + \overline{MN}$

$\overline{LN} = 1 + 1$

$\overline{LN} = 2\text{cm}$

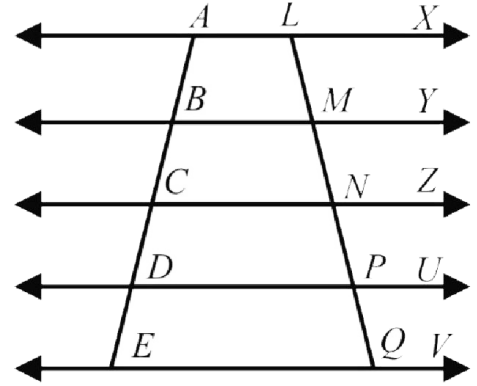
$\overline{LM} = \overline{NP} = \overline{PQ} = \overline{MN} = 1\text{cm}$

So, $\overline{LM} = 1\text{cm}, \overline{NP} = 1\text{cm}, \overline{PQ} = 1\text{cm}$

$\overline{LQ} = \overline{LM} + \overline{MN} + \overline{NP} + \overline{PQ}$

$\overline{LQ} = 1 + 1 + 1 + 1$

$\overline{LQ} = 4\text{cm}$



Q.2 Take a line segment of length 5.5cm and divide it into five congruent parts

[Hint: draw an acute angle $\angle BAX$. On

\overline{AX} take $\overline{AP} \cong \overline{PQ} \cong \overline{QR} \cong \overline{RS} \cong \overline{ST}$ join T to B draw

lines parallel to \overline{TB} from the point P, Q, R and S .

Proof

Construction:

(i) Take a line segment $AB = 5.5\text{cm}$

(ii) Draw any acute angle $\angle BAX$

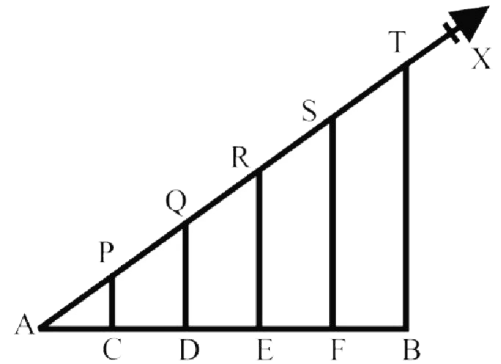
(iii) Draw arcs on \overline{AX} which are

$\overline{AP} \cong \overline{PQ} \cong \overline{QR} \cong \overline{RS} \cong \overline{ST}$

(iv) Join T to B

(v) Draw lines $\overline{SF}, \overline{RE}, \overline{QD}, \& \overline{PC}$ Parallel to \overline{TB} .

Result line segment \overline{AB} is divided into congruent line segments $\overline{AC} \cong \overline{CD} \cong \overline{DE} \cong \overline{EF} \cong \overline{FB}$.



Review Exercise 11

Q.1 Fill in the blanks

(i) In a parallelogram opposite side are

Ans: Congruent

(ii) In a parallelogram opposite angles are

Ans: Congruent

(iii) Diagonals of a parallelogram each other at a point.

Ans: Bisects

(iv) Medians of a triangle are

Ans: Concurrent

(v) Diagonals of a parallelogram divide the parallelogram into two Triangles

Ans: Congruent

Q.2 In parallelogram $ABCD$

(i) $m\overline{AB} = \dots\dots\dots$

Ans: $m\overline{AB} = m\overline{DC}$

(ii) $m\overline{BC} \dots\dots\dots$

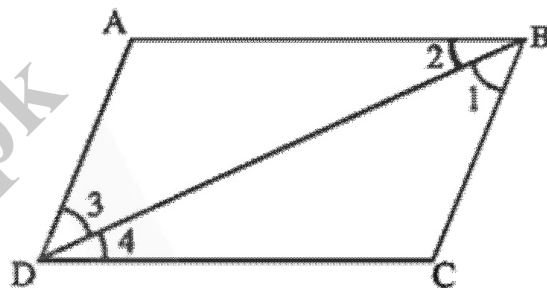
Ans: $m\overline{BC} = m\overline{AD}$

(iii) $m\angle 1 \cong \dots\dots\dots$

Ans: $m\angle 1 = m\angle 3$

(iv) $m\angle 2 = \dots\dots\dots$

Ans: $m\angle 2 = m\angle 4$



Q.3 Find the unknown in the figure given

Solution

$$n^\circ = 75$$

$$y^\circ = n^\circ$$

Substituting the value of n°

$$y^\circ = 75^\circ$$

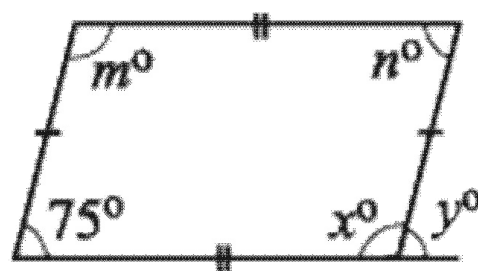
$$x^\circ + 75 = 180 \text{ Adjacent and supplementary}$$

$$x^\circ = 180 - 75$$

$$x^\circ = 105^\circ$$

$$m^\circ = x^\circ$$

$$m^\circ = 105^\circ$$



Q.4 If the given figure $ABCD$ is a parallelogram then find x , m

$$11x^\circ = 55^\circ$$

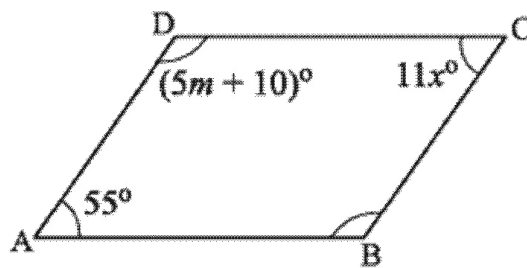
$$x^\circ = \frac{55^\circ}{11}$$

$$x^\circ = 5^\circ$$

$$\angle A + \angle B = 180^\circ$$

$$\angle B = 180^\circ - \angle A$$

$$\angle B = 180^\circ - 55^\circ = 125^\circ$$



$$\angle B = 130^\circ$$

$$\angle D + \angle C = 180^\circ$$

$$5m + 10^\circ + 55^\circ = 180^\circ$$

$$5m + 65^\circ = 180^\circ$$

$$5m = 180^\circ - 65^\circ$$

$$5m = 115^\circ$$

$$m = \frac{115^\circ}{5^\circ}$$

$$m = 23^\circ$$

Q.5 The given figure $\angle MNP$ is a parallelogram finds the value of m, n

$$4m + n = 10 \dots \dots \dots (i)$$

In parallelogram opposite sides are congruent $8m - 4n = 8 \dots (ii)$

Multiply 4 with equation

$$4(4m + n) = 4 \times 10$$

$$16m + 4n = 40 \dots (iii)$$

Adding equation (ii) and (iv)

$$8m - 4n = 8$$

$$16m + 4n = 40$$

$$24m = 48$$

$$m = \frac{48}{24}$$

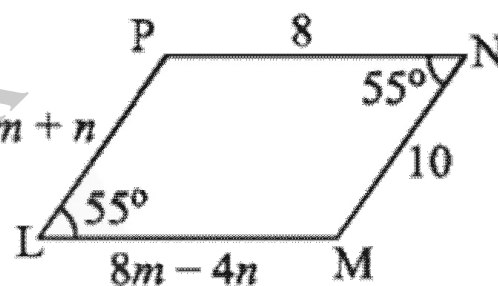
$$m = 2$$

Putting the value of m in equation (i) $4(2) + n = 10$

$$8 + n = 10$$

$$n = 10 - 8$$

$$n = 2$$



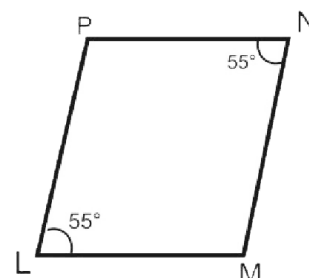
Q.6 In the equation 5, sum of the opposite angles of the parallelogram in 110°

$$\angle L + \angle M = 180$$

$$55^\circ + \angle M = 180^\circ$$

$$\angle M = 180^\circ - 55^\circ$$

$$\angle M = 125^\circ$$



$\angle P = \angle M$ opposite angles are congruent in parallelogram

$\angle P = 125^\circ$

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