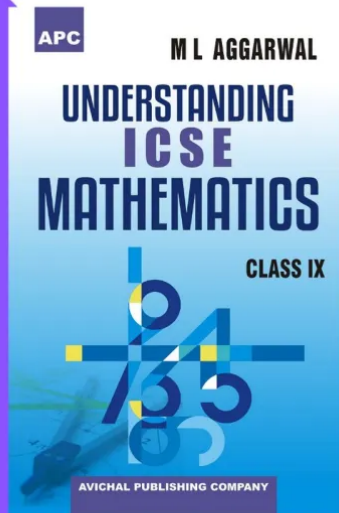


ML Aggarwal Solutions for Class 9 Maths

Chapter 11- Mid Point Theorem



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ML Agrawal Solutions

CLASS 9 MATHS

Chapter 11: Mid Point
Theorem

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Chapter 11- Mid Point Theorem

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ML Aggarwal Solutions for Class 9 Maths Chapter 11- Mid Point Theorem

ML Aggarwal 9th Maths Chapter 11, Class 9 Maths Chapter 11 solutions

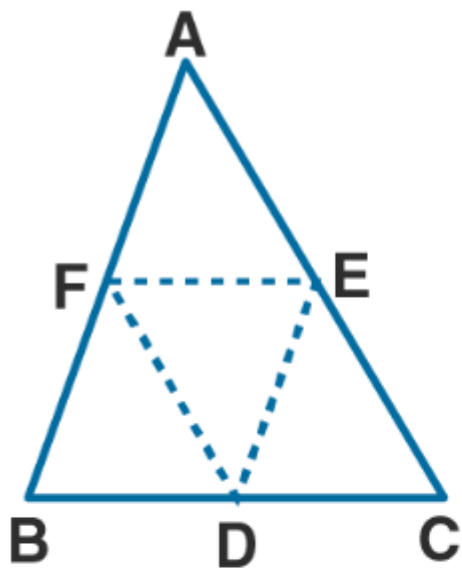
Exercise 11

1. (a) In the figure (1) given below, D, E and F are mid-points of the sides BC, CA and AB respectively of ΔABC . If $AB = 6$ cm, $BC = 4.8$ cm and $CA = 5.6$ cm, find the perimeter of (i) the trapezium FBCE (ii) the triangle DEF.

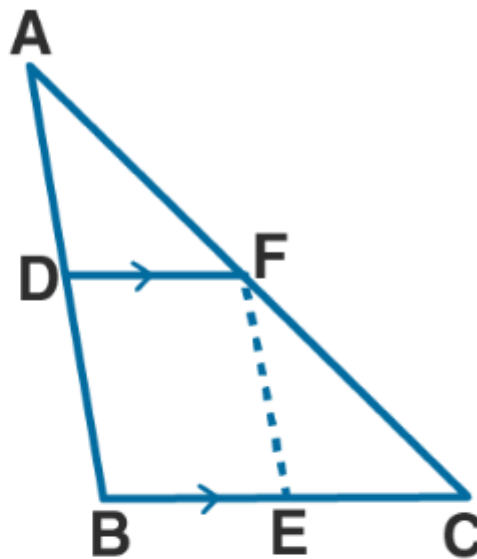
(b) In the figure (2) given below, D and E are mid-points of the sides AB and AC respectively. If $BC = 5.6$ cm and $\angle B = 72^\circ$, compute (i) DE (ii) $\angle ADE$.

(c) In the figure (3) given below, D and E are mid-points of AB, BC respectively and $DF \parallel BC$. Prove that DBEF is a parallelogram. Calculate AC if $AF = 2.6$ cm.

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(1)



(3)



(2)

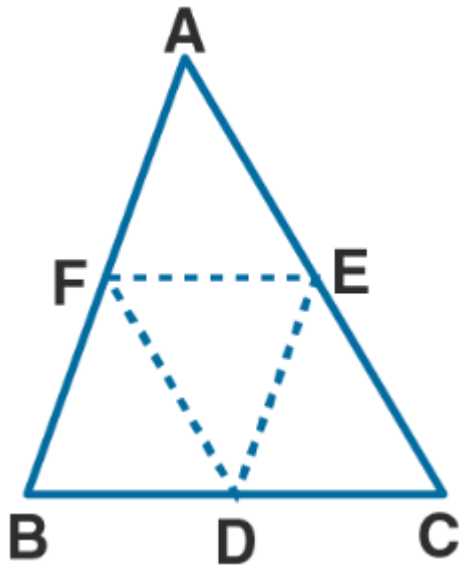
Solution:

(a) (i) It is given that

$AB = 6$ cm, $BC = 4.8$ cm and $CA = 5.6$ cm

To find: The perimeter of trapezium FBCA

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It is given that

F is the mid-point of AB

We know that

$$BF = \frac{1}{2} AB = \frac{1}{2} \times 6 = 3 \text{ cm} \dots\dots (1)$$

It is given that

E is the mid-point of AC

We know that

$$CE = \frac{1}{2} AC = \frac{1}{2} \times 5.6 = 2.8 \text{ cm} \dots\dots (2)$$

Here F and E are the mid-point of AB and CA

$$FE \parallel BC$$

We know that

$$FE = \frac{1}{2} BC = \frac{1}{2} \times 4.8 = 2.4 \text{ cm} \dots\dots (3)$$

Here

$$\text{Perimeter of trapezium FBCE} = BF + BC + CE + EF$$

Now substituting the value from all the equations

$$= 3 + 4.8 + 2.8 + 2.4$$

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$$= 13 \text{ cm}$$

Therefore, the perimeter of trapezium FBCE is 13 cm.

(ii) D, E and F are the midpoints of sides BC, CA and AB of $\triangle ABC$

Here $EF \parallel BC$

$$EF = \frac{1}{2} BC = \frac{1}{2} \times 4.8 = 2.4 \text{ cm}$$

$$DE = \frac{1}{2} AB = \frac{1}{2} \times 6 = 3 \text{ cm}$$

$$FD = \frac{1}{2} AC = \frac{1}{2} \times 5.6 = 2.8 \text{ cm}$$



We know that

$$\text{Perimeter of } \triangle DEF = DE + EF + FD$$

Substituting the values

$$= 3 + 2.4 + 2.8$$

$$= 8.2 \text{ cm}$$

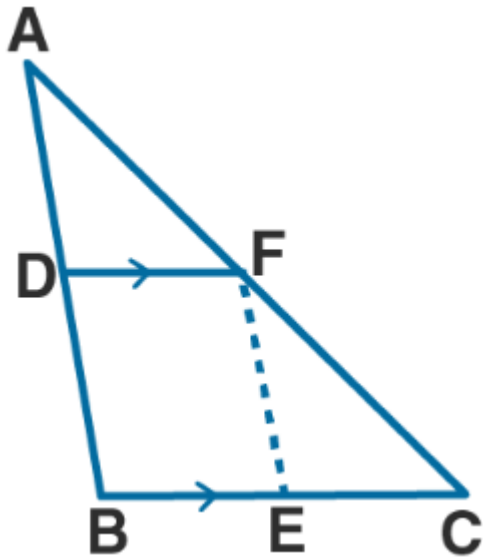
(b) It is given that

D and E are the mid-point of sides AB and AC

$$BC = 5.6 \text{ cm and } \angle B = 72^\circ$$

To find: (i) DE (ii) $\angle ADE$

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We know that

In $\triangle ABC$

D and E is the mid-point of the sides AB and AC

Using mid-point theorem

$DE \parallel BC$

(i) $DE = \frac{1}{2} BC = \frac{1}{2} \times 5.6 = 2.8 \text{ cm}$

(ii) $\angle ADE = \angle B$ are corresponding angles

It is given that

$\angle B = 72^\circ$ and $BC \parallel DE$

$\angle ADE = 72^\circ$

(c) It is given that

D and E are the midpoints of AB and BC respectively

$DF \parallel BC$ and $AF = 2.6 \text{ cm}$

To find: (i) BEF is a parallelogram

(ii) Calculate the value of AC

Proof:

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(i) In ΔABC

D is the midpoint of AB and $DF \parallel BC$

F is the midpoint of AC (1)

F and E are the midpoints of AC and BC

$EF \parallel AB$ (2)

Here $DF \parallel BC$

$DF \parallel BE$ (3)

Using equation (2)

$EF \parallel AB$

$EF \parallel DB$ (4)

Using equation (3) and (4)

DBEF is a parallelogram

(ii) F is the midpoint of AC

So we get

$$AC = 2 \times AF = 2 \times 2.6 = 5.2 \text{ cm}$$

2. Prove that the four triangles formed by joining in pairs the mid-points of the sides C of a triangle are congruent to each other.

Solution:

It is given that

In ΔABC

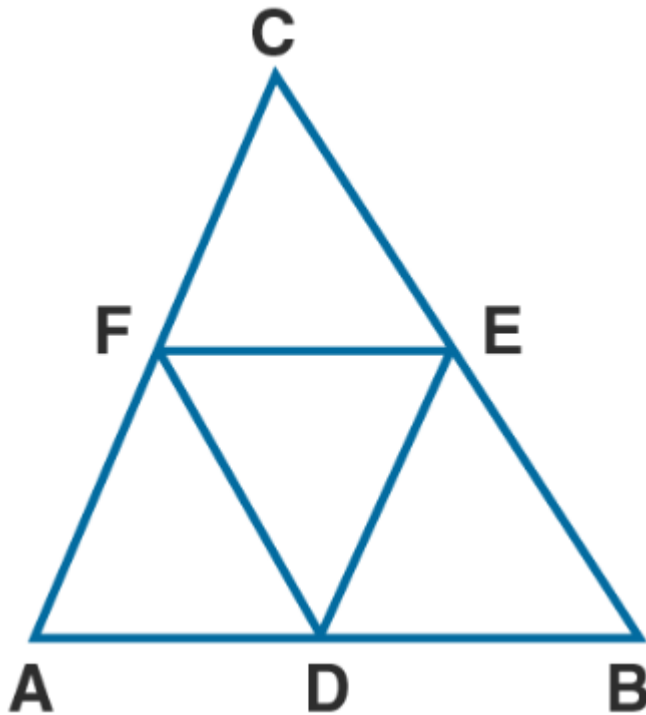
D, E and F are the mid-points of AB, BC and CA

Now join DE, EF and FD

To find:

$$\Delta ADF \cong \Delta DBE \cong \Delta ECF \cong \Delta DEF$$

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To prove:

In $\triangle ABC$

D and E are the mid-points of AB and BC

$DE \parallel AC$ or FC

Similarly $DF \parallel EC$

DECF is a parallelogram

We know that

Diagonal FE divides the parallelogram DECF in two congruent triangles DEF and CEF

$\triangle DEF \cong \triangle ECF$ (1)

Here we can prove that

$\triangle DBE \cong \triangle DEF$ (2)

$\triangle DEF \cong \triangle ADF$ (3)

Using equation (1), (2) and (3)

$\triangle ADF \cong \triangle DBE \cong \triangle ECF \cong \triangle DEF$

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3. If D, E and F are mid-points of sides AB, BC and CA respectively of an isosceles triangle ABC, prove that ΔDEF is also isosceles.

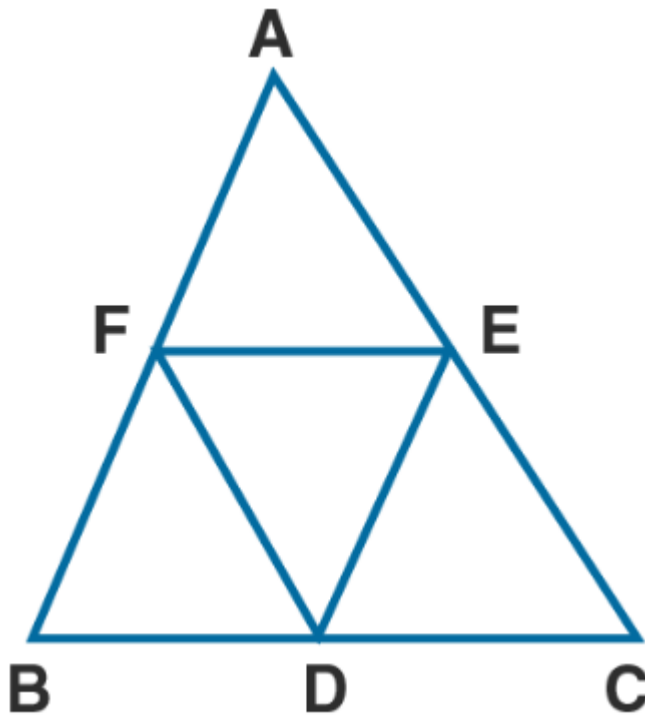
Solution:

It is given that

ABC is an isosceles triangle in which $AB = AC$

D, E and F are the midpoints of the sides BC, CA and AB

Now D, E and F are joined



To find:

ΔDEF is an isosceles triangle

Proof:

D and E are the midpoints of BC and AC

Here $DE \parallel AB$ and $DE = \frac{1}{2} AB$ (1)

D and F are the midpoints of BC and AB

Here $DF \parallel AC$ and $DF = \frac{1}{2} AC$ (2)

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It is given that

$$AB = BC \text{ and } DE = DF$$

Hence, $\triangle DEF$ is an isosceles triangle.

4. The diagonals AC and BD of a parallelogram ABCD intersect at O. If P is the midpoint of AD, prove that

(i) $PQ \parallel AB$

(ii) $PO = \frac{1}{2} CD$.

Solution:

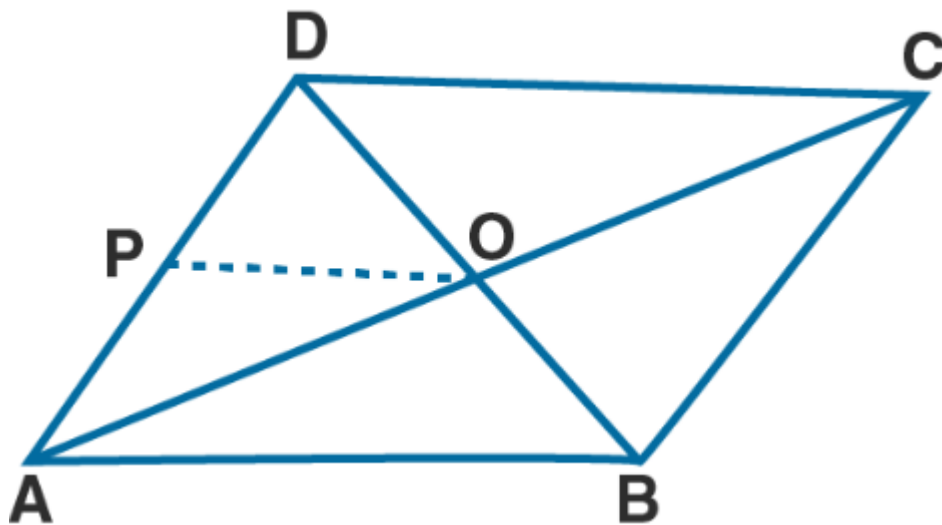
It is given that

ABCD is a parallelogram in which diagonals AC and BD intersect each other

At the point O, P is the midpoint of AD

Join OP

To find: (i) $PQ \parallel AB$ (ii) $PQ = \frac{1}{2} CD$



Proof:

(i) In parallelogram diagonals bisect each other

$$BO = OD$$

Here O is the mid-point of BD

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In $\triangle ABD$

P and O is the midpoint of AD and BD

$PO \parallel AB$ and $PO = \frac{1}{2} AB$ (1)

Hence, it is proved that $PO \parallel AB$.

(ii) ABCD is a parallelogram

$AB = CD$ (2)

Using both (1) and (2)

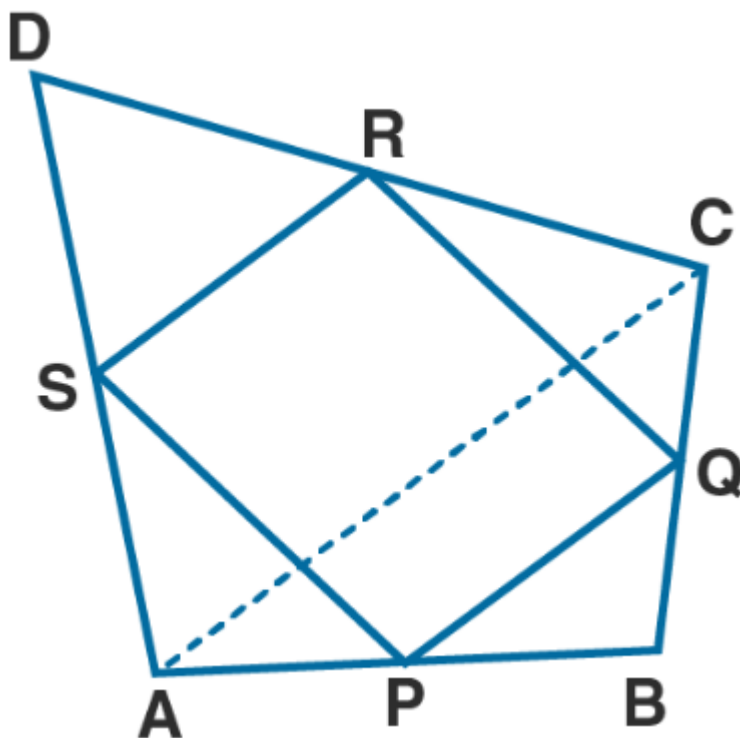
$PO = \frac{1}{2} CD$

5. In the adjoining figure, ABCD is a quadrilateral in which P, Q, R and S are mid-points of AB, BC, CD and DA respectively. AC is its diagonal. Show that

(i) $SR \parallel AC$ and $SR = \frac{1}{2} AC$

(ii) $PQ = SR$

(iii) PQRS is a parallelogram.



Solution:

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It is given that

In quadrilateral ABCD

P, Q, R and S are the mid-points of sides AB, BC, CD and DA

AC is the diagonal

To find:

(i) $SR \parallel AC$ and $SR = \frac{1}{2} AC$

(ii) $PQ = SR$

(iii) PQRS is a parallelogram

Proof:

(i) In $\triangle ADC$

S and R are the mid-points of AD and DC

$SR \parallel AC$ and $SR = \frac{1}{2} AC$ (1) Using the mid-point theorem

(ii) In $\triangle ABC$

P and Q are the midpoints of AB and BC

$PQ \parallel AC$ and $PQ = \frac{1}{2} AC$ (2)

Using equation (1) and (2)

$PQ = SR$ and $PQ \parallel SR$

(iii) $PQ = SR$ and $PQ \parallel SR$

Hence, PQRS is a parallelogram.

6. Show that the quadrilateral formed by joining the mid-points of the adjacent sides of a square, is also a square.

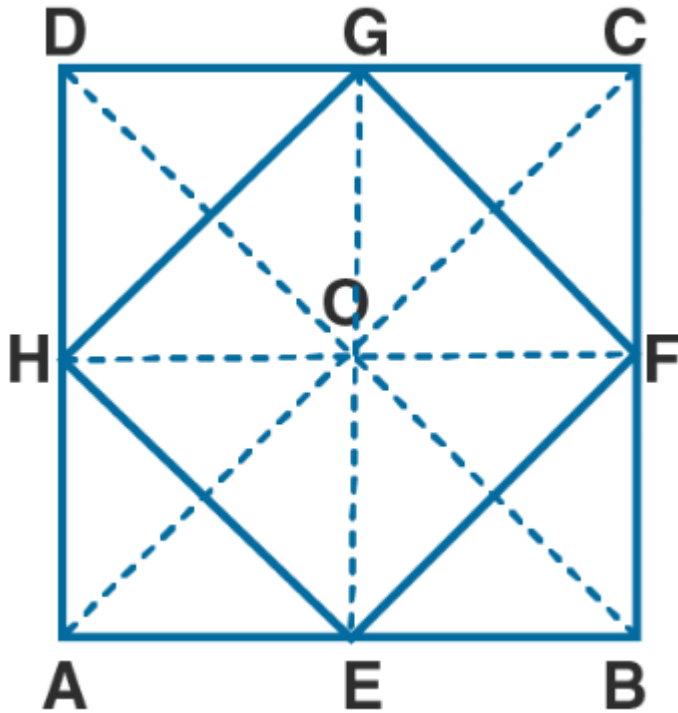
Solution:

It is given that

A square ABCD in which E, F, G and H are mid-points of AB, BC, CD and DA

Join EF, FG, GH and HE.

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To find:

EFGH is a square

Construct AC and BD

Proof:

In $\triangle ACD$

G and H are the mid-points of CD and AC

$GH \parallel AC$ and $GH = \frac{1}{2} AC$ (1)

In $\triangle ABC$, E and F are the mid-points of AB and BC

$EF \parallel AC$ and $EF = \frac{1}{2} AC$ (2)

Using both the equations

$EF \parallel GH$ and $EF = GH = \frac{1}{2} AC$ (3)

In the same way we can prove that

$EF \parallel GH$ and $EH = GF = \frac{1}{2} BD$

We know that the diagonals of square are equal

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$$AC = BD$$

By dividing both sides by 2

$$\frac{1}{2} AC = \frac{1}{2} BD \dots (4)$$

Using equation (3) and (4)

$$EF = GH = EH = GF \dots (5)$$

Therefore, EFGH is a parallelogram

In $\triangle GOH$ and $\triangle GOF$

$OH = OF$ as the diagonals of parallelogram bisect each other

$OG = OG$ is common

Using equation (5)

$$GH = GF$$

$\triangle GOH \cong \triangle GOF$ (SSS axiom of congruency)

$$\angle GOH = \angle GOF \text{ (c.p.c.t.)}$$

We know that

$$\angle GOH + \angle GOF = 180^\circ \text{ as it is a linear pair}$$

$$\angle GOH + \angle GOH = 180^\circ$$

So we get

$$2 \angle GOH = 180^\circ$$

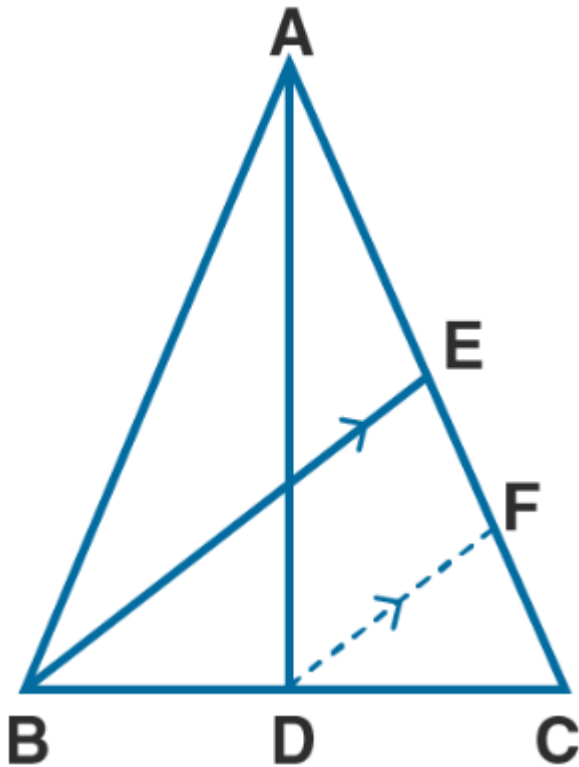
$$\angle GOH = 180^\circ / 2 = 90^\circ$$

So the diagonals of a parallelogram ABCD bisect and perpendicular to each other

Hence, it is proved that EFGH is a square.

7. In the adjoining figure, AD and BE are medians of $\triangle ABC$. If $DF \parallel BE$, prove that $CF = \frac{1}{4} AC$.

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**Solution:**

It is given that

AD and BE are the medians of $\triangle ABC$

Construct $DF \parallel BE$

To find:

$$CF = \frac{1}{4} AC$$

Proof:

In $\triangle BCE$

D is the mid-point of BC and $DF \parallel BE$

F is the mid-point of EC

$$CF = \frac{1}{2} EC \dots\dots (1)$$

E is the mid-point of AC

$$EC = \frac{1}{2} AC \dots\dots (2)$$

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Using both the equations

$$CF = \frac{1}{2} EC = \frac{1}{2} (\frac{1}{2} AC)$$

So we get

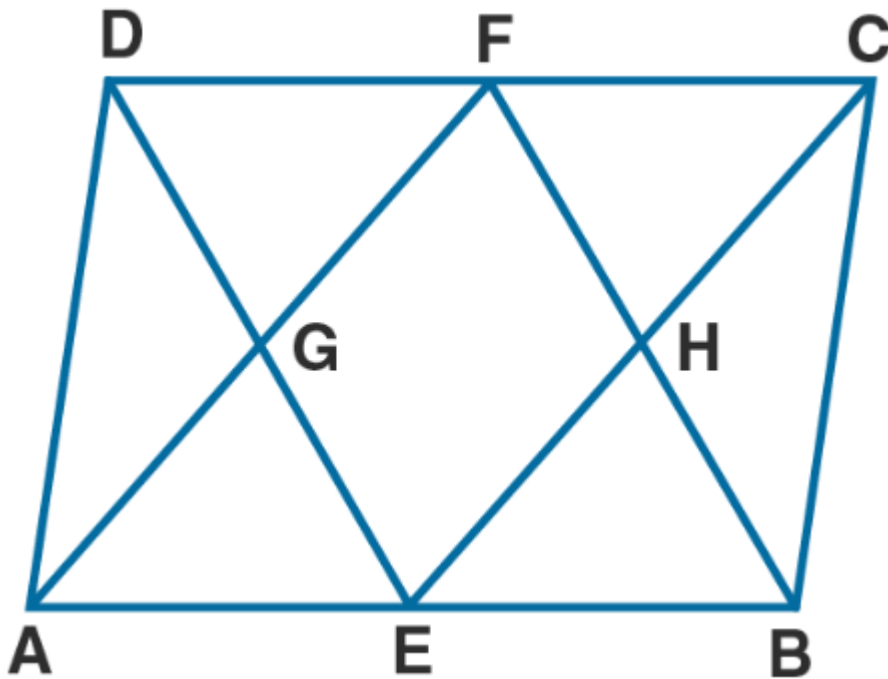
$$CF = \frac{1}{4} AC$$

Hence, it is proved.

8. In the figure (1) given below, ABCD is a parallelogram. E and F are mid-points of the sides AB and CO respectively. The straight lines AF and BF meet the straight lines ED and EC in points G and H respectively. Prove that

(i) $\Delta HEB = \Delta HCF$

(ii) GEHF is a parallelogram.



Solution:

It is given that

ABCD is a parallelogram

E and F are the mid-points of sides AB and CD

To prove:

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(i) $\Delta HEB = \Delta HCF$

(ii) GEHF is a parallelogram

Proof:

(i) We know that

ABCD is a parallelogram

$$FC \parallel BE$$

$\angle CEB = \angle FCE$ are alternate angles

$$\angle HEB = \angle FCH \dots (1)$$

$\angle EBF = \angle CFB$ are alternate angles

$$\angle EBH = \angle CFM \dots (2)$$

Here E and F are mid-points of AB and CD

$$BE = \frac{1}{2} AB \dots (3)$$

$$CF = \frac{1}{2} CD \dots (4)$$

We know that

ABCD is a parallelogram

$$AB = CD$$

Now dividing both sides by $\frac{1}{2}$

$$\frac{1}{2} AB = \frac{1}{2} CD$$

Using equation (3) and (4)

$$BE = CF \dots (5)$$

In ΔHEB and ΔHCF

$$\angle HEB = \angle FCH \text{ using equation (1)}$$

$$\angle EBH = \angle CFH \text{ using equation (2)}$$

$$BE = CF \text{ using equation (5)}$$

So we get

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$\triangle HEB \cong \triangle HCF$ (ASA axiom of congruency)

Hence, it is proved.

(ii) It is given that

E and F are the mid-points of AB and CD

$AB = CD$

So we get

$AE = CF$

Here $AE \parallel CF$

$AE = CF$ and $AE \parallel CF$

So AECF is a parallelogram.

G and H are the mid-points of AF and CE

$GF \parallel EH$ (6)

In the same way we can prove that GFHE is a parallelogram

So G and H are the points on the line DE and BF

$GE \parallel HF$ (7)

Using equation (6) and (7) GEHF is a parallelogram.

Hence, it is proved.

9. ABC is an isosceles triangle with $AB = AC$. D, E and F are mid-points of the sides BC, AB and AC respectively. Prove that the line segment AD is perpendicular to EF and is bisected by it.

Solution:

It is given that

ABC is an isosceles triangle with $AB = AC$

D, E and F are mid-points of the sides BC, AB and AC

To find:

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AD is perpendicular to EF and is bisected by it.

Proof:

In $\triangle ABD$ and $\triangle ACD$

ABC is an isosceles triangle

$$\angle ABD = \angle ACD$$

Here D is the mid-point of BC

$$BD = CD$$

It is given that $AB = AC$

$\triangle ABD \cong \triangle ACD$ (SAS axiom of congruency)

$$\angle ADB = \angle ADC \text{ (c. p. c. t)}$$

We know that

$$\angle ADB + \angle ADC = 180^\circ \text{ is a linear pair}$$

$$\angle ADB + \angle ADB = 180^\circ$$

By further calculation

$$2 \angle ADB = 180^\circ$$

So we get

$$\angle ADB = 180/2 = 90^\circ$$

So AD is perpendicular to BC (1)

D and E are the mid-points of BC and AB

$$DE \parallel AC \text{ (2)}$$

D and F are the mid-points of BC and AC

$$EF \parallel AB \text{ (3)}$$

Using equation (2) and (3)

AEDF is a parallelogram.

Here the diagonals of a parallelogram bisect each other

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AD and EF bisect each other

Using equation (1) and (3)

$EF \parallel BC$

So AD is perpendicular to EF

Hence, it is proved.

10. (a) In the quadrilateral (1) given below, $AB \parallel DC$, E and F are the mid-points of AD and BD respectively. Prove that:

(i) G is mid-point of BC

(ii) $EG = \frac{1}{2} (AB + DC)$

(b) In the quadrilateral (2) given below, $AB \parallel DC \parallel EG$. If E is mid-point of AD prove that:

(i) G is the mid-point of BC

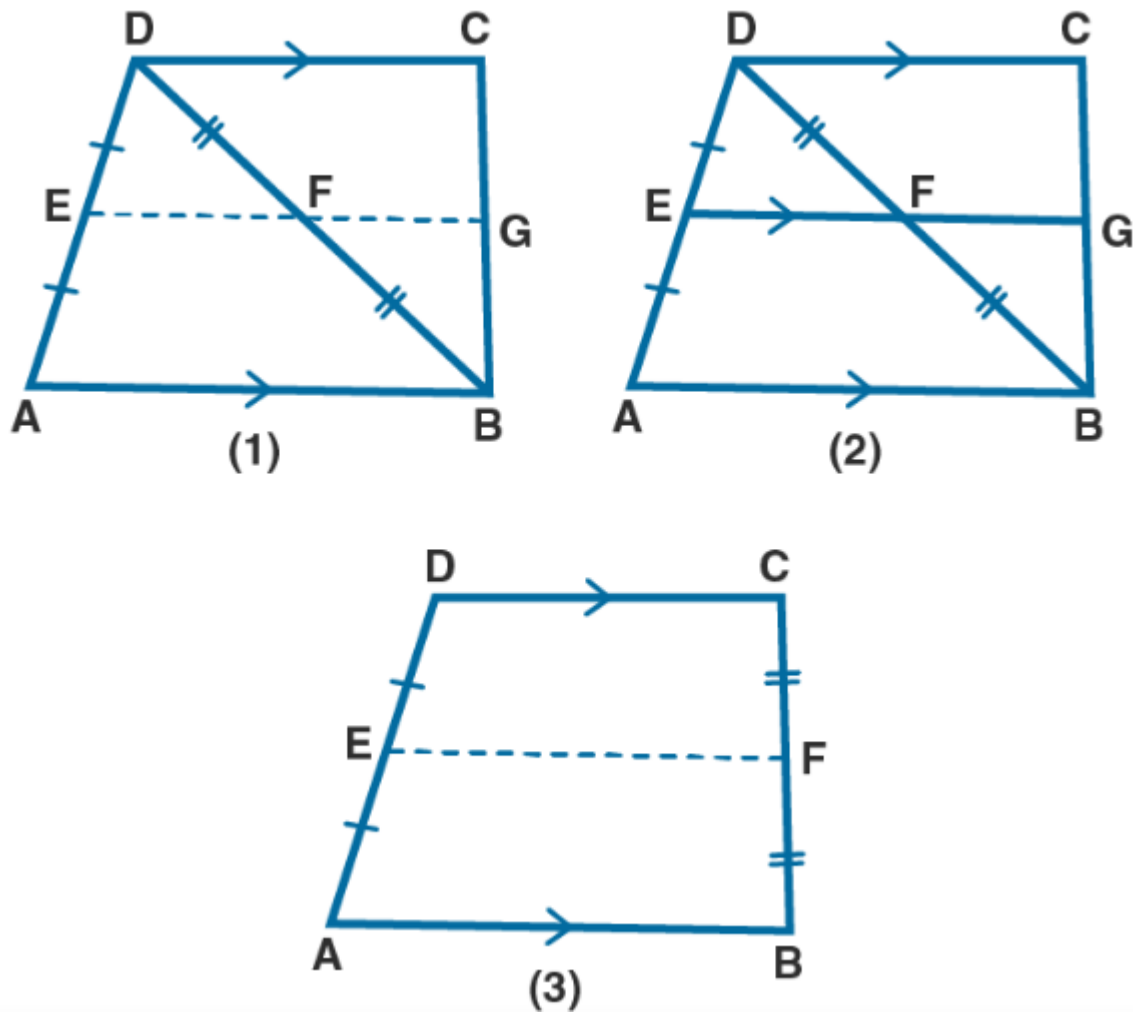
(ii) $2EG = AB + CD$

(c) In the quadrilateral (3) given below, $AB \parallel DC$.

E and F are mid-point of non-parallel sides AD and BC respectively. Calculate:

(i) EF if $AB = 6$ cm and $DC = 4$ cm.

(ii) AB if $DC = 8$ cm and $EF = 9$ cm.

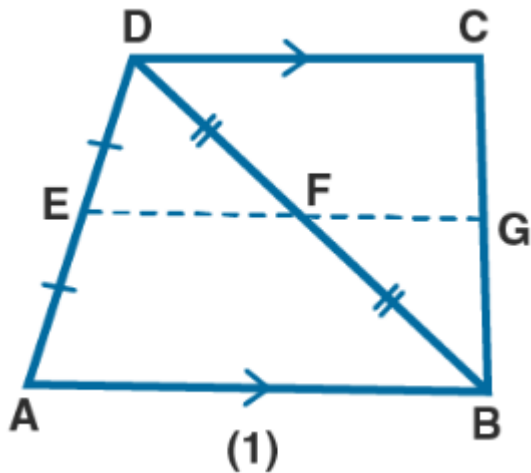


Solution:

(a) It is given that

AB || DC, E and F are mid-points of AD and BD

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To prove:

(i) G is mid-point of BC

(ii) $EG = \frac{1}{2} (AB + DC)$

Proof:

In $\triangle ABD$

F is the mid-point of BD

$DF = BF$

E is the mid-point of AD

$EF \parallel AB$ and $EF = \frac{1}{2} AB$ (1)

It is given that $AB \parallel CD$

$EG \parallel CD$

F is the mid-point of BD

$FG \parallel DC$

G is the mid-point of BC

$FG = \frac{1}{2} DC$ (2)

By adding both the equations

$EF + FG = \frac{1}{2} AB + \frac{1}{2} DC$

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Taking $\frac{1}{2}$ as common

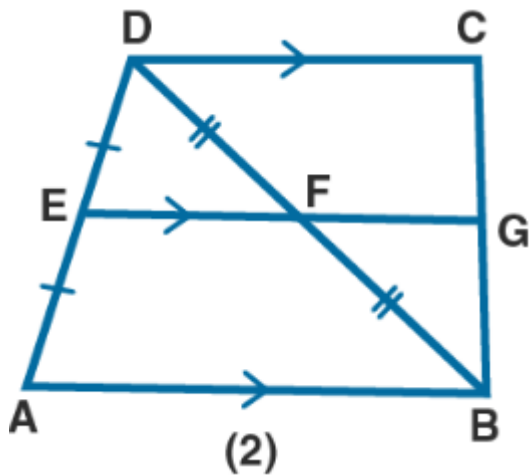
$$EG = \frac{1}{2} (AB + DC)$$

Therefore, it is proved.

(b) It is given that

Quadrilateral ABCD in which $AB \parallel DC \parallel EG$

E is the mid-point of AD



To prove:

(i) G is the mid-point of BC

(ii) $2EG = AB + CD$

Proof:

$AB \parallel DC$

$EG \parallel AB$

So we get

$EG \parallel DC$

In $\triangle DAB$,

E is the mid-point of BD and $EF = \frac{1}{2} AB$ (1)

In $\triangle BCD$,

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F is the mid-point of BD and $FG \parallel DC$

$$FG = \frac{1}{2} CD \dots\dots (2)$$

By adding both the equations

$$EF + FG = \frac{1}{2} AB + \frac{1}{2} CD$$

Taking out the common terms

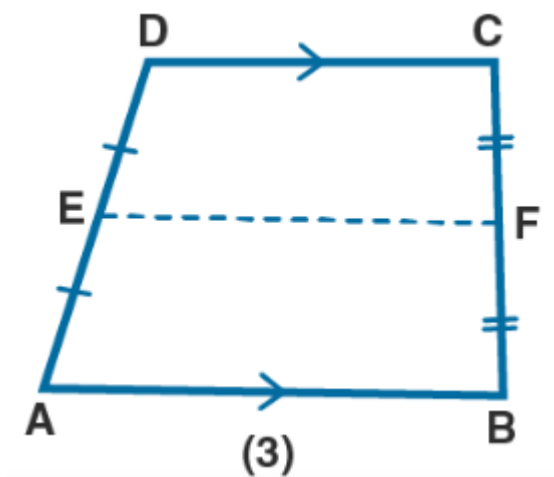
$$EG = \frac{1}{2} (AB + CD)$$

Hence, it is proved.

(c) It is given that

A quadrilateral in which $AB \parallel DC$

E and F are the mid-points of non-parallel sides AD and BC



To prove:

(i) $EF = \frac{1}{2}(AB + DC)$ if $AB = 6$ cm and $DC = 4$ cm.

(ii) $AB = 2EF - DC$ if $DC = 8$ cm and $EF = 9$ cm.

Proof:

We know that

The length of line segment joining the mid-points of two non-parallel sides is half the sum of the lengths of the parallel sides

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E and F are the mid-points of AD and BC

$$EF = \frac{1}{2} (AB + CD) \dots\dots (1)$$

(i) $AB = 6 \text{ cm}$ and $DC = 4 \text{ cm}$

Substituting in equation (1)

$$EF = \frac{1}{2} (6 + 4)$$

By further calculation

$$EF = \frac{1}{2} \times 10 = 5 \text{ cm}$$

(ii) $DC = 8 \text{ cm}$ and $EF = 9 \text{ cm}$

Substituting in equation (1)

$$EF = \frac{1}{2} (AB + DC)$$

By further calculation

$$9 = \frac{1}{2} (AB + 8)$$

$$18 = AB + 8$$

So we get

$$18 - 8 = AB$$

$$AB = 10 \text{ cm}$$

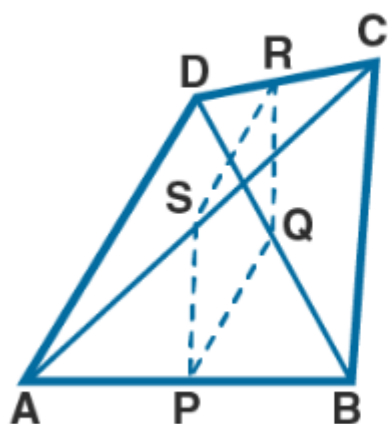
11. (a) In the quadrilateral (1) given below, $AD = BC$, P, Q, R and S are mid-points of AB, BD, CD and AC respectively. Prove that PQRS is a rhombus.

(b) In the figure (2) given below, ABCD is a kite in which $BC = CD$, $AB = AD$, E, F, G are mid-points of CD, BC and AB respectively. Prove that:

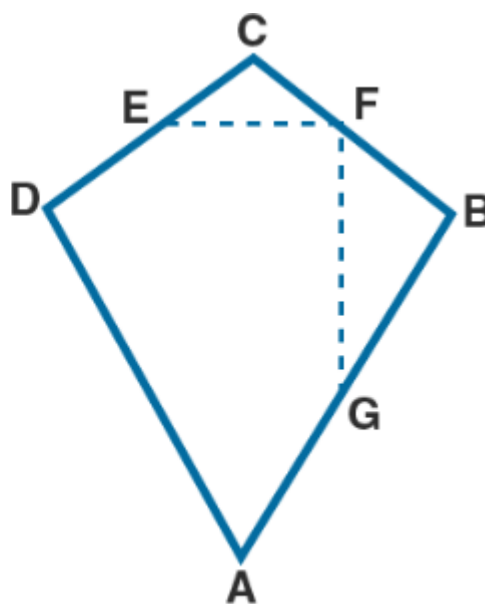
(i) $\angle EFG = 90^\circ$

(ii) The line drawn through G and parallel to FE bisects DA.

<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-11-mid-point-theorem/>



(1)



(2)

Solution:

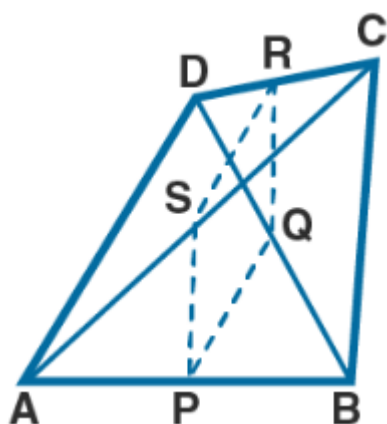
(a) It is given that

A quadrilateral ABCD in which $AD = C$

P, Q, R and S are mid-points of AB, BD, CD and AC

To prove:

PQRS is a rhombus



Proof:

<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-11-mid-point-theorem/>

In $\triangle ABD$

P and Q are mid points of AB and BD

$PQ \parallel AD$ and $PQ = \frac{1}{2} AB$ (1)

In $\triangle BCD$,

R and Q are mid points of DC and BD

$RQ \parallel BC$ and $RQ = \frac{1}{2} BC$ (2)

P and S are mid-points of AB and AC

$PS \parallel BC$ and $PS = \frac{1}{2} BC$ (3)

$AD = BC$

Using all the equations

$PS \parallel RQ$ and $PQ = PS = RQ$

Here $PS \parallel RQ$ and $PS = RQ$

PQRS is a parallelogram

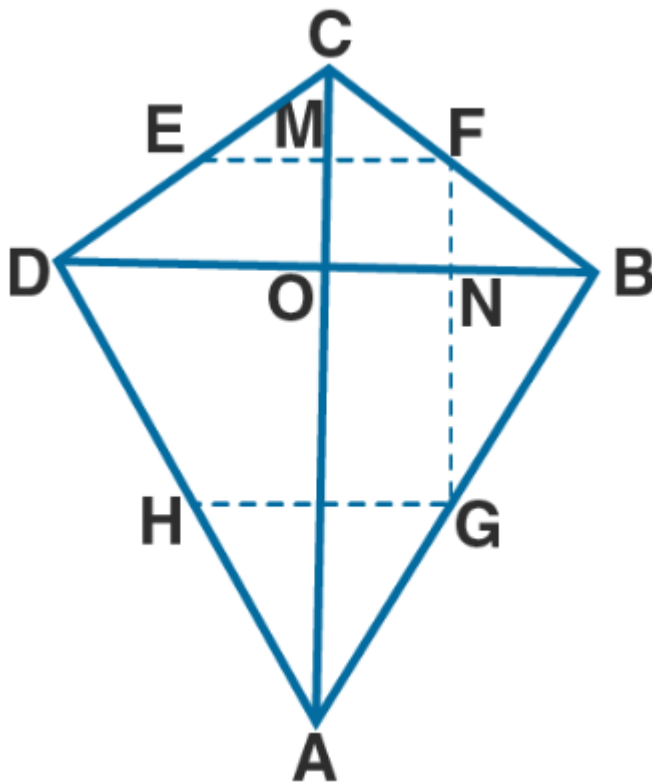
$PQ = RS = PS = RQ$

PQRS is a rhombus

Therefore, it is proved.

(ii) It is given that

ABCD is a kite in which $BC = CD$, $AB = AD$, E, F, G are mid-points of CD, BC and AB



To prove:

(i) $\angle EFG = 90^\circ$

(ii) The line drawn through G and parallel to FE bisects DA

Construction:

Join AC and BD

Construct GH through G parallel to FE

Proof:

(i) We know that

Diagonals of a kite intersect at right angles

$$\angle MON = 90^\circ \dots\dots (1)$$

In $\triangle BCD$

E and F are mid-points of CD and BC

$$EF \parallel DB \text{ and } EF = \frac{1}{2} DB \dots\dots (2)$$

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$EF \parallel DB$

$MF \parallel ON$

Here

$$\angle MON + \angle MFN = 180^\circ$$

$$90^\circ + \angle MFN = 180^\circ$$

By further calculation

$$\angle MFN = 180 - 90 = 90^\circ$$

$$\text{So } \angle EFG = 90^\circ$$

Hence, it is proved.

(ii) In $\triangle ABD$

G is the mid-point of AB and $HG \parallel DB$

Using equation (2)

$EF \parallel DB$ and $EF \parallel HG$

$HG \parallel DB$

Here H is the mid-point of DA

Therefore, the line drawn through G and parallel to FE bisects DA.

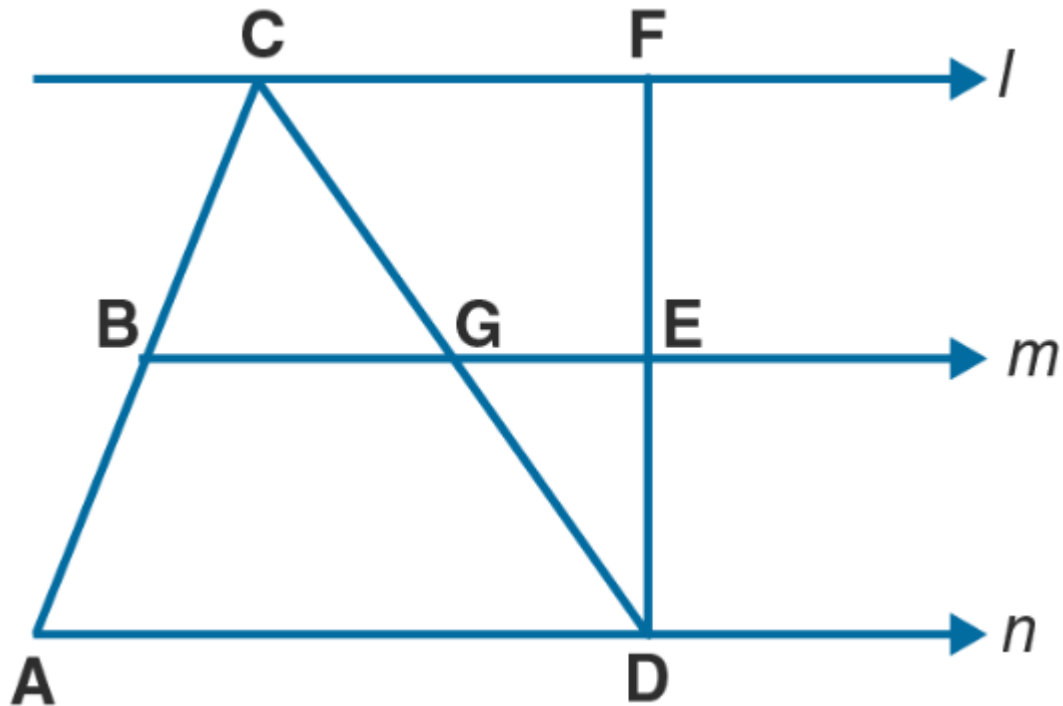
12. In the adjoining figure, the lines l, m and n are parallel to each other, and G is mid-point of CD. Calculate:

(i) BG if AD = 6 cm

(ii) CF if GE = 2.3 cm

(iii) AB if BC = 2.4 cm

(iv) ED if FD = 4.4 cm



Proof:

(i) In $\triangle ACD$,

G is the mid-point of CD

BG $\parallel$ AD as $m \parallel n$

Here B is the mid-point of AC and $BG = \frac{1}{2} AD$

So we get

$$BG = \frac{1}{2} \times 6 = 3 \text{ cm}$$

(ii) In $\triangle CDF$

G is the mid-point of CD

GE $\parallel$ CF as $m \parallel l$

Here E is the mid-point of DF and $GE = \frac{1}{2} CF$

So we get

$$CF = 2GE$$

$$CF = 2 \times 2.3 = 4.6 \text{ cm}$$

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(iii) From (i)

B is the mid-point of AC

$$AB = BC$$

We know that

$$BC = 2.4 \text{ cm}$$

$$\text{So } AB = 2.4 \text{ cm}$$

(iv) From (ii)

E is the mid-point of FD

$$ED = \frac{1}{2} FD$$

We know that

$$FD = 4.4 \text{ cm}$$

$$ED = \frac{1}{2} \times 4.4 = 2.2 \text{ cm}$$

Chapter Test

1. ABCD is a rhombus with P, Q and R as midpoints of AB, BC and CD respectively. Prove that $PQ \perp QR$.

Solution:

It is given that

ABCD is a rhombus with P, Q and R as mid-points of AB, BC and CD

To prove:

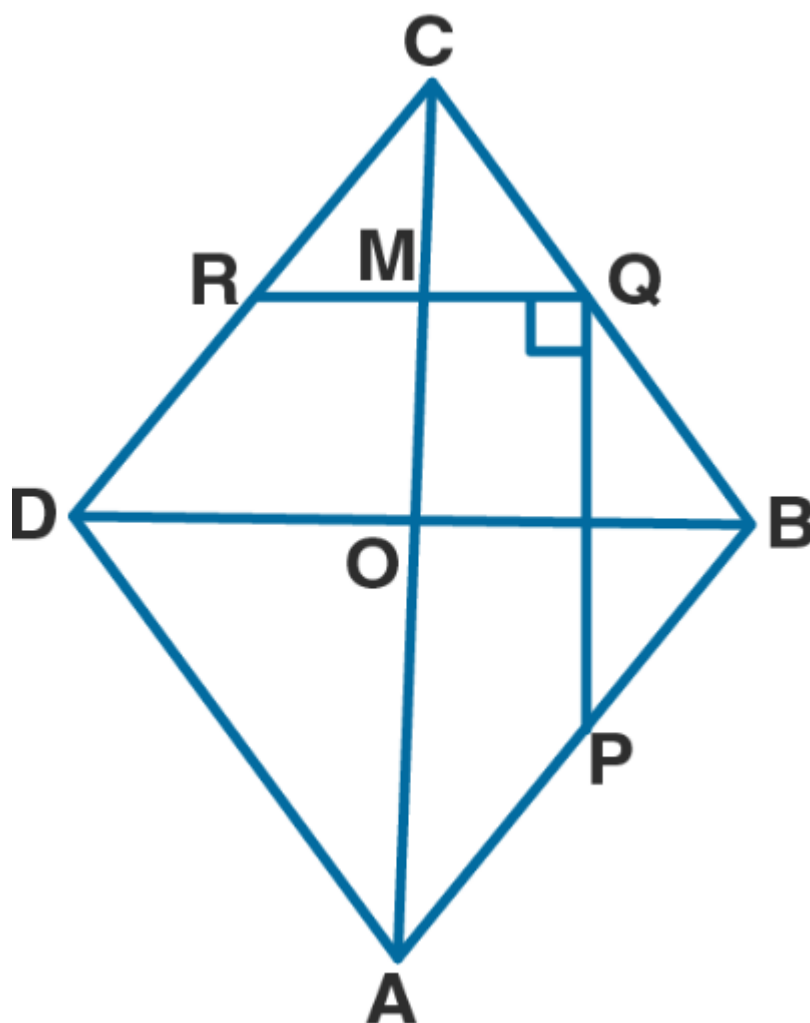
$$PQ \perp QR$$

Construction: Join AC and BD

Proof:

Diagonals of rhombus intersect at right angle

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$$\angle MON = 90^\circ \dots\dots (1)$$

In $\triangle BCD$

Q and R are mid-points of BC and CD.

$$RQ \parallel DB \text{ and } RQ = \frac{1}{2} DB \dots\dots (2)$$

Here

$$RQ \parallel DB$$

$$MQ \parallel ON$$

We know that

$$\angle MQN + \angle MON = 180^\circ$$

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Substituting the values

$$\angle MQN + 90^\circ = 180^\circ$$

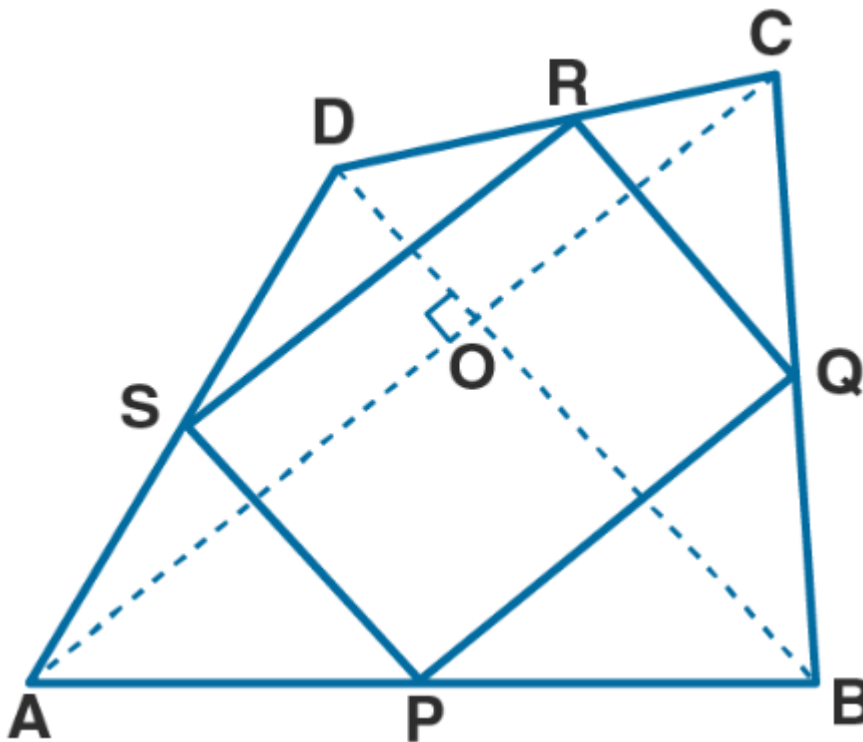
$$\angle MQN = 180 - 90 = 90^\circ$$

So $NQ \perp MQ$ or $PQ \perp QR$

Hence, it is proved.

2. The diagonals of a quadrilateral ABCD are perpendicular. Show that the quadrilateral formed by joining the mid-points of its adjacent sides is a rectangle.

Solution:



It is given that

ABCD is a quadrilateral in which diagonals AC and BD are perpendicular to each other

P, Q, R and S are mid-points of AB, BC, CD and DA

To prove:

PQRS is a rectangle

Proof:

<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-11-mid-point-theorem/>

We know that

P and Q are the mid-points of AB and BC

$PQ \parallel AC$ and $PQ = \frac{1}{2} AC$ (1)

S and R are mid-points of AD and DC

$SR \parallel AC$ and $SR = \frac{1}{2} AC$ (2)

Using both the equations

$PQ \parallel SR$ and $PQ = SR$

So PQRS is a parallelogram

AC and BD intersect at right angles

$SP \parallel BD$ and $BD \perp AC$

So $SP \perp AC$ i.e. $SP \perp SR$

$\angle RSP = 90^\circ$

$\angle RSP = \angle SRQ = \angle RQS = \angle SPQ = 90^\circ$

Hence, PQRS is a rectangle.

3. If D, E, F are mid-points of the sides BC, CA and AB respectively of a ΔABC , prove that AD and FE bisect each other.

Solution:

It is given that

D, E, F are mid-points of sides BC, CA and AB of a ΔABC

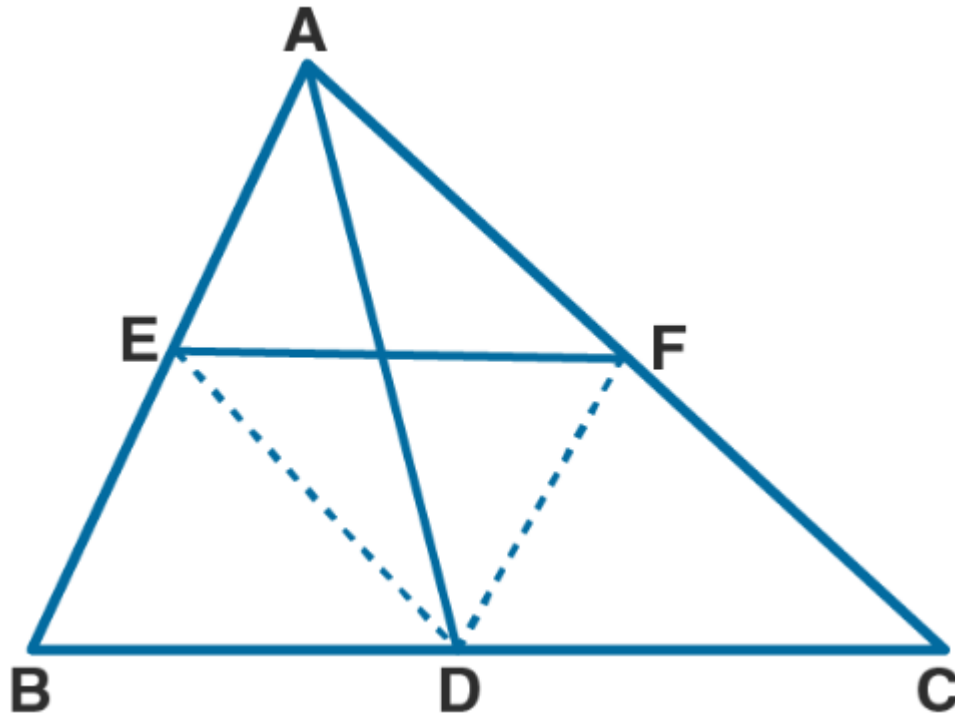
To prove:

AD and FE bisect each other

Construction:

Join ED and FD

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Proof:

We know that

D and E are the midpoints of BC and AB

$DE \parallel AC$ and $DE \parallel AF$ (1)

D and F are the midpoints of BC and AC

$DF \parallel AB$ and $DF \parallel AE$ (2)

Using both the equations

ADEF is a parallelogram

Here the diagonals of a parallelogram bisect each other

AD and EF bisect each other.

Therefore, it is proved.

4. In ΔABC , D and E are mid-points of the sides AB and AC respectively. Through E, a straight line is drawn parallel to AB to meet BC at F. Prove that BDEF is a parallelogram. If $AB = 8$ cm and $BC = 9$ cm, find the perimeter of the parallelogram BDEF.

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Solution:

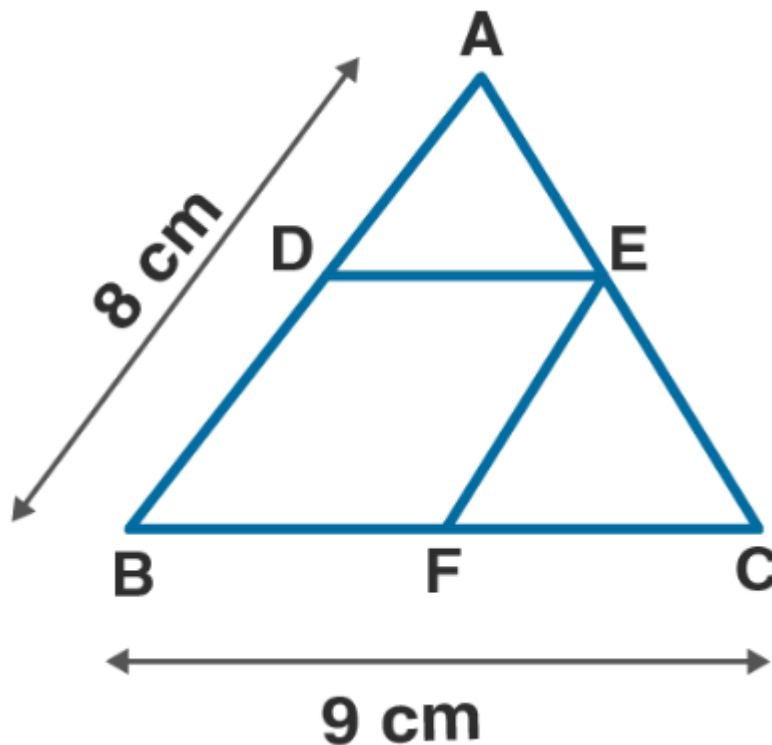
It is given that

In $\triangle ABC$

D and E are the mid points of sides AB and AC

DE is joined from E

EF $\parallel$ AB is drawn AB = 8 cm and BC = 9 cm



To prove:

- (i) BDEF is a parallelogram
- (ii) Find the perimeter of BDEF

Proof:

In $\triangle ABC$

D and E are the mid-points of AB and AC

Here DE $\parallel$ BC and DE = $\frac{1}{2}$ BC

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So $EF \parallel AB$

DEFB is a parallelogram

$DE = BF$

So we get

$$DE = \frac{1}{2} BC = \frac{1}{2} \times 9 = 4.5 \text{ cm}$$

$$EF = \frac{1}{2} AB = \frac{1}{2} \times 8 = 4 \text{ cm}$$

We know that

$$\text{Perimeter of BDEF} = 2 (DE + EF)$$

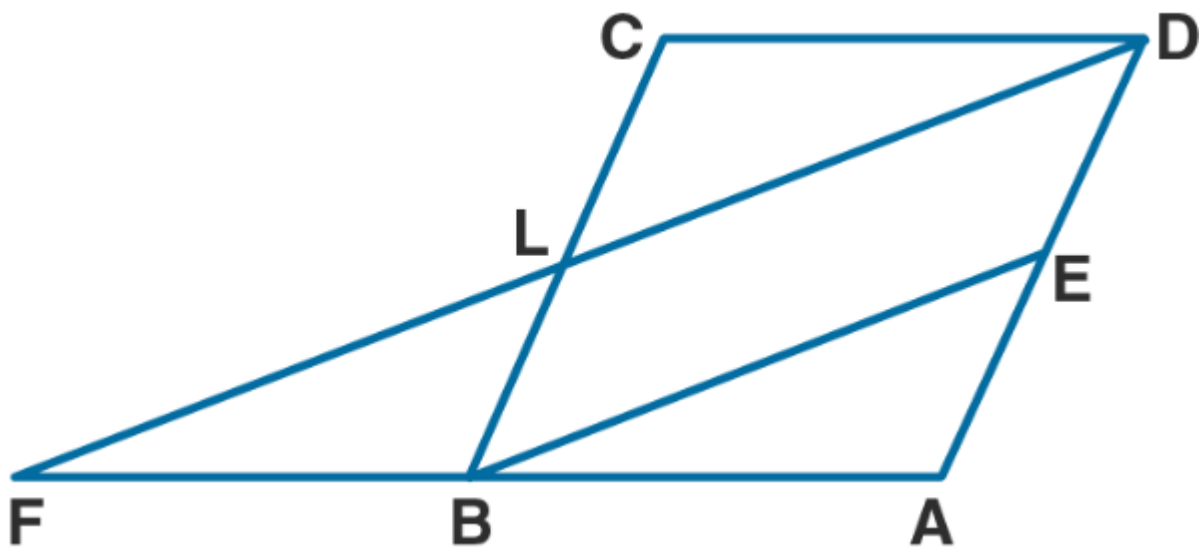
Substituting the values

$$= 2 (4.5 + 4)$$

$$= 2 \times 8.5$$

$$= 17 \text{ cm}$$

5. In the given figure, ABCD is a parallelogram and E is mid-point of AD. DL $\parallel$ EB meets AB produced at F. Prove that B is mid-point of AF and $EB = LF$.



Solution:

It is given that

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ABCD is a parallelogram

E is the mid-point of AD

DL || EB meets AB produced at F

To prove:

EB = LF

B is the mid-point of AF

Proof:

We know that

BC || AD and BE || LD

BEDL is a parallelogram

BE = LD and BL = AE

Here E is the mid-point of AD

L is the mid-point of BC

In $\triangle FAD$

E is the mid-point of AD and BE || LD at FLD

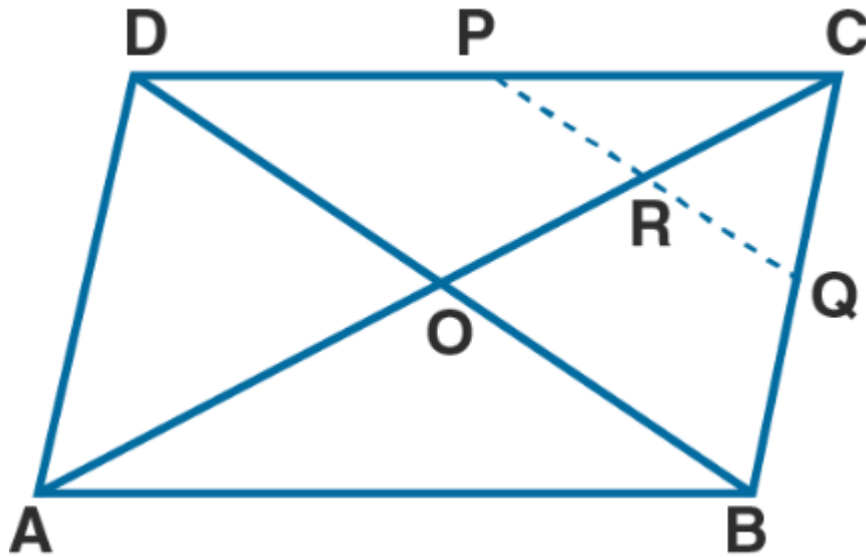
So B is the mid-point of AF

Here

EB = $\frac{1}{2}$ FD = LF

6. In the given figure, ABCD is a parallelogram. If P and Q are mid-points of sides CD and BC respectively, show that CR = $\frac{1}{2}$ AC.

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**Solution:**

It is given that

ABCD is a parallelogram

P and Q are mid-points of CD and BC

To prove: $CR = \frac{1}{4} AC$

Construction: Join AC and BD

Proof:

In parallelogram ABCD

Diagonals AC and BD bisect each other at O

$AO = OC$ or $OC = \frac{1}{2} AC$ (1)

In $\triangle BCD$

P and Q are mid points of CD and BC

$PQ \parallel BD$

In $\triangle BCO$

Q is the mid-point of BC and $PQ \parallel OB$

Here is the mid-point of CO

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So we get

$$CR = \frac{1}{2} OC = \frac{1}{2} \left(\frac{1}{2} BC\right)$$

$$CR = \frac{1}{4} BC$$

Hence, it is proved.



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- Chapter 5- Simultaneous Linear Equations
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About ML Aggarwal

M. L. Aggarwal, is an Indian mechanical engineer, educator. His achievements include research in solutions of industrial problems related to fatigue design. Recipient Best Paper award, Manipal Institute of Technology, 2004. Member of TSTE.

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