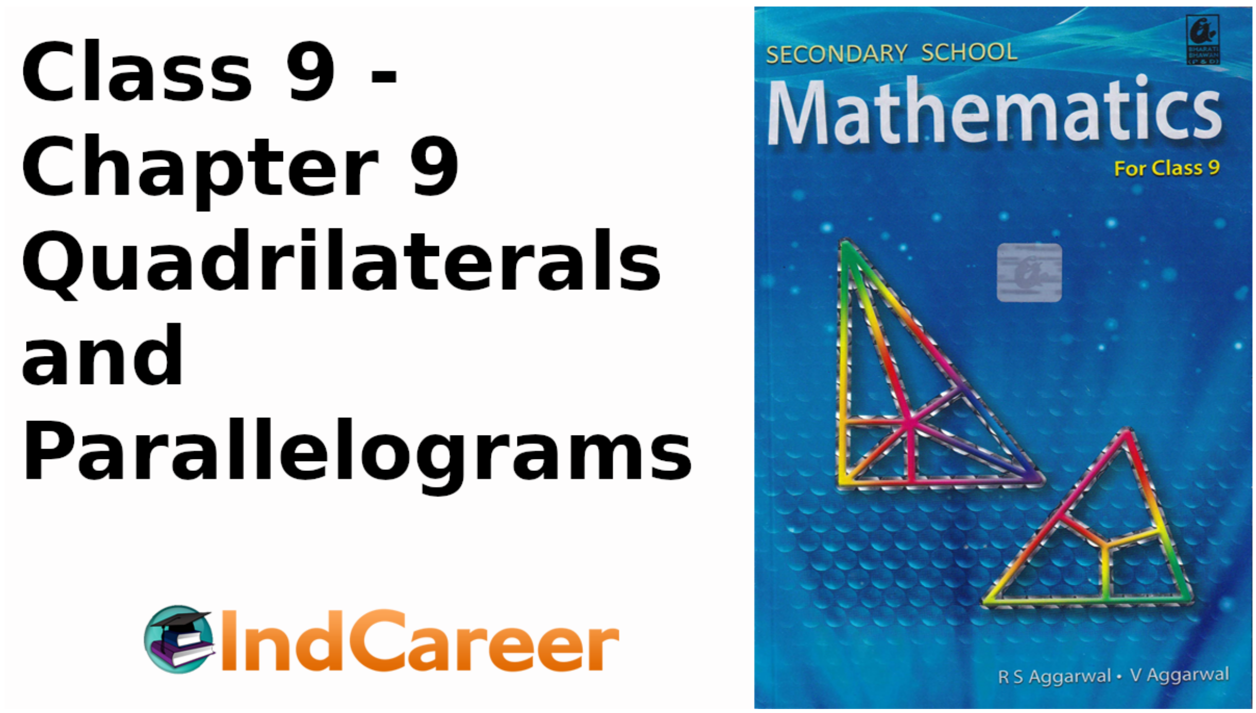
RS Aggarwal Solutions for Class 9 Maths Chapter 9–Quadrilaterals and Parallelograms



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RS Aggarwal Solutions for Class 9 Maths Chapter 9–Quadrilaterals and Parallelograms

Class 9: Maths Chapter 9 solutions. Complete Class 9 Maths Chapter 9 Notes.

RS Aggarwal Solutions for Class 9 Maths Chapter 9–Quadrilaterals and Parallelograms

RS Aggarwal 9th Maths Chapter 9, Class 9 Maths Chapter 9 solutions

Ex 9A

Question 1.

Solution:

We know that sum of angles of a quadrilateral is 360°

Now, sum of three angles = 56° + 115° + 84° = 255°

Fourth angle = 360° – 255° = 105° Ans.

Question 2.

Solution:

Sum of angles of a quadrilateral = 360°

Their ratio = 2 : 4 : 5 : 7

Let first angle = 2x

then second angle = 4x

third angle = 5x

and fourth angle = 7x

∴ 2x + 4x + 5x + 7x = 360°

=> 18x = 360°

=> x = 360o18 = 20°

Hence, first angle = 2x = 2 x 20° = 40°

Second angle = 4x = 4 x 20° = 80°

Third angle = 5x = 5 x 20° = 100°

and fourth angle = 7x = 7 x 20° = 140°Ans.

Question 3.

Solution:

In the trapezium ABCD

DC || AB

∴ ∠ A + ∠ D = 180° (Co-intericr angles)

∴ 55°+ ∠D = 180°

∠D = 180° – 55°

∴ ∠D = 125°

Similarly, ∠B + ∠C = 180°

(Co-interior angles)

=> 70° + ∠C = 180°

=> ∠C = 180° – 70°

∠C = 110°

Hence ∠C = 110° and ∠D = 125° Ans.

Question 4.

Solution:

Given : In the figure, ABCD is a square and Δ EDC is an equilateral triangles on DC. AE and BE are joined.

To Prove : (i) AE = BE

(ii) ∠DAE = 15°

Proof : In Δ ADE and ABCE

AD = BC (Sides of a square)

DE = CE (Sides of equilateral triangle)

∠ADE = ∠BCE

(Each = $90^\circ + 60^\circ = 150^\circ$)

∴ Δ ADE ≅ Δ BCE (SAS axiom)

∴ AE = BE (c.p.c.t.).

In Δ ADE,

∠DAE = ∠DEA (∵ AD = DE)

But ∠ADE = $90^\circ + 60^\circ = 150^\circ$

∴ ∠DAE + ∠DEA = $180^\circ - 150^\circ = 30^\circ$

⇒ ∠DAE + ∠DAE = 30°

(∵ ∠DAE = ∠DEA)

⇒ 2∠DAE = 30°

⇒ ∠DAE = $\frac{30^\circ}{2} = 15^\circ$

(∵ ∠DAE = ∠DEA)

Hence ∠DAE = 15°

Hence proved.

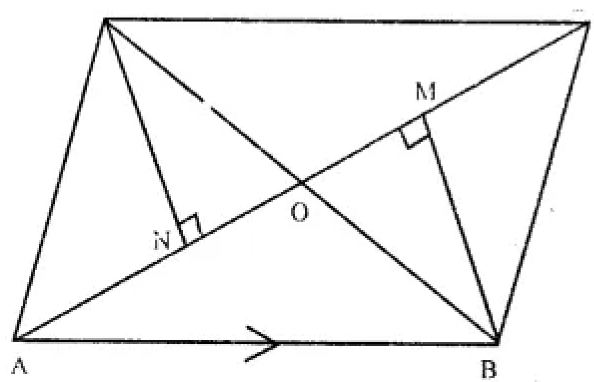
Question 5.

Solution:

Given : In the figure,

BM ⊥ AC, DN ⊥ AC.

BM = DN



To Prove : AC bisects BD.

Proof : In Δ BMO and Δ DNO,

BM = DN (given)

$\angle M = \angle N$ (each 90^o)

$\angle BOM = \angle DON$

(vertically opposite angles)

$\because \Delta BMO \cong \Delta DNO$ (AAS axiom)

$\therefore$ DO = OB. (c.p.c.t.)

Hence AC bisects BD at O.

Hence proved.

Question 6.

Solution:

Given : In quadrilateral ABCD,

AB = AD and BC = DC

AC is joined.

To Prove : (i) AC bisects ∠ A and ∠ C

(ii) BE = DE

(iii) ∠ABC = ∠ADC

Const. Join BD.

Proof : (i) In Δ ABC and Δ ADB

AB = AD (given)
BC = DC (given)
AC = AC (common)
∴ Δ ABC ≅ Δ ADB (S.S.S. axiom)
∴ ∠BAC = ∠DAC (c.p.c.t.)
∠BCA = ∠DCA (c.p.c.t.)
and ∠ABC = ∠ADC (c.p.c.t.)
Hence AC, bisects ∠A and ∠C
and ∠ABC = ∠ADC
(ii) Now, in Δ ABE and Δ ADE,
AE = AE (common)
AB = AD (given)
∠BAE = ∠DAE (proved.)
(∵ ∠BAC = ∠DAC)
∴ Δ ABE ≅ Δ ADE (SAS axiom)
∴ BE = DE (c.p.c.t.)
Hence proved.

Question 7.

Solution:

Given : In square ABCD,

$\angle$ PQR = 90°

PB = QC = DR

To Prove : (i) QB = RC

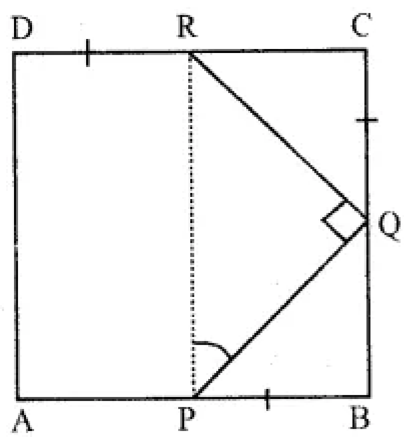
(ii) PQ = QR

(iii) $\angle QPR = 45^\circ$

Const. Join PR

Proof : $\because$ DC = CB (sides of a squares)

and DR = QC (given)



Subtracting,

DC – DR = CB – QC

$\Rightarrow$ RC = QB

Now in ΔPBQ and ΔQCR,

PB = QC (given)

QB = QC (proved)

$\angle B = \angle C$ (each 90°)

$\therefore \Delta PBQ \cong \Delta QCR$ (SAS axiom)

$\therefore PQ = QR$ (c.p.c.t.)

Now in ΔPQR,

$PQ = QR$ (proved)

$\therefore \angle QPR = \angle QRP$ (angles opposite to equal sides)

But $\angle PQR = 90^\circ$ (given)

$\therefore \angle QPR + \angle QRP = 90^\circ$

$\Rightarrow \angle QPR + \angle QPR = 90^\circ$

$\Rightarrow 2\angle QPR = 90^\circ$

$$\Rightarrow \angle QPR = \frac{90^\circ}{2} = 45^\circ$$

Hence proved.

Question 8.

Solution:

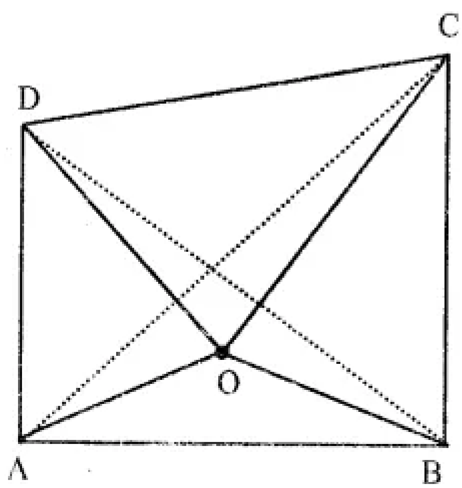
Given : In quadrilateral ABCD, O is any point inside it. OA, OB, OC and OD are joined.

To Prove : OA + OB + OC + OD > AC + BD

Construction. Join AC and BD.

Proof : In Δ AOC,

OA + OC > AC (sum of two sides of a triangle is greater than its third side)



Similarly in Δ BOD,

OB + OD > BD

Adding we get :

OA + OC + OB + OD > AC + BD

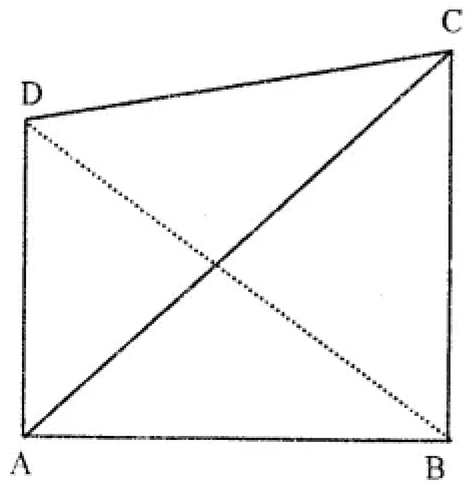
$\Rightarrow$ OA + OB + OC + OD > AC + BD

Hence proved..

Question 9.

Solution:

Given : In quadrilateral ABCD, AC is its one diagonal.



To Prove : (i) AB + BC + CD + DA > 2AC

(ii) AB + BC + CD > DA

(iii) AB + BC + CD + DA > AC + BD

Const. Join BD.

Proof :

(i) In Δ ABC,

AB + BC > AC ...(*i*)

(Sum of two sides of a triangle is greater than its third side)

Similarly, in Δ ADC

AD + DC > AC ...(*ii*)

Adding (i) and (ii)

AB + BC + AD + DC > AC + AC

$\Rightarrow$ AB + BC + CD + DA > 2AC

(ii) In Δ ABC,

AB + BC > AC [proved in (i)]

Adding CD both sides,

AB + BC + CD > AC + CD

But in Δ ADC,

AC + CD > AD

$\therefore$ AB + BC + CD > AC + CD > AD

Hence AB + BC + CD > DA

(iii) In (i) we have proved that

AB + BC + CD + DA > 2AC ...(A)

Similarly by joining BD, we can prove that

AB + BC + CD + DA > 2BD ...(B)

Adding (A) and (B)

Q(AB + BC + CD + DA) > 2AC + 2BD

$\Rightarrow$ 2(AB + BC + CD + DA) > 2(AC + BD)

$\Rightarrow$ AB + BC + CD + DA > AC + BD (Dividing by 2)

Hence AB + BC + CD + DA > AC + BD

Hence proved.

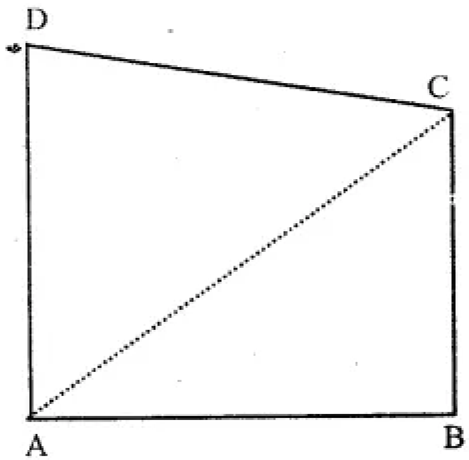
Question 10.

Solution:

Given : A quadrilateral ABCD

To Prove : $\angle A + \angle B + \angle C + \angle D = 360°$

Const. Join AC.



Proof : In Δ ABC,

$\angle CAB + \angle B + \angle BCA = 180^o$ ...(i)

(Angles of a triangle)

Similarly in Δ ADC,

$\angle CAD + \angle D + \angle ACD = 180^o$ ...(ii)

Adding (i) and (ii)

$\angle CAB + \angle B + \angle BCA + \angle CAD + \angle D + \angle ACD = 180^o + 180^o$

$\Rightarrow \angle CAB + \angle CAD + \angle B + \angle BCA + \angle ACD + \angle D = 360^o$

$\Rightarrow \angle A + \angle B + \angle C + \angle D = 360^o$

Hence proved.

Ex 9A

Question 1.

Solution:

In parallelogram ABCD.

∠ A = 72°

But ∠ A = ∠ C (opposite angle of a ||gm)

∴ ∠ C = 72°

∴ AD || BC

∴ ∠ A + ∠ B = 180° (co-interior angles)

=> 72° + ∠B = 180°

=> ∠B = 180° – 72°

=> ∠B = 108°

But ∠ B = ∠ D (opposite angles of a ||gm)

∴ ∠D = 108°

Hence ∠D = 108°, ∠ C = 72° and ∠ D = 108° Ans.

Question 2.

Solution:

In || gm ABCD, BD is its diagonal

and ∠DAB = 80° and ∠DBC = 60°

∴AB || DC

∴∠DAB + ∠ADC – 180°

(co-interior angles)

=> 80° + ∠ADC = 180°

=> ∠ ADC = 180° – 80°

=> ∠ ADC = 100°

But ∠ ADB = ∠ DBC (Alternate angles)

∴∠ ADB = 60°

But ∠ ADB + ∠ CDB = 100°

(∴∠ ADC = 100°)

60° + ∠CDB = 100°

=> ∠CDB = 100° – 60° = 40°

Hence ∠CDB = 40° and ∠ ADB = 60° Ans.

Question 3.

Solution:

Given : In ||gm ABCD,

∠ A = 60° Bisectors of ∠ A and ∠ B meet DC at P.

To Prove : (i) ∠APB = 90°

(ii) AD = DP and PB = PC = BC

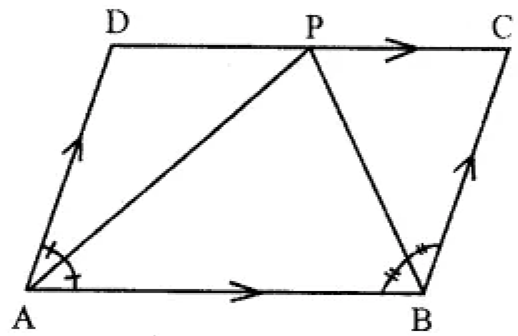
(iii) DC = 2AD

Proof: ∴ AD || B (opposite sides of a ||gm)

∴∠ A + ∠ B = 180° (co-interior angles)

But AP and BP are the bisectors of ∠A and ∠B

∴12∠A + 12 ∠B = 90°



=> ∠PAB + ∠PBA = 90°

But in Δ APB,

∠PAB + ∠PBA + ∠APB = 180° (angles of a triangle)

=> 90° + ∠APB = 180°

=> ∠APB = 180° – 90° = 90°

Hence ∠APB = 90°

(ii) ∠ A + ∠ D = 180° (co-interior angles)

and ∠ A – 60°

∴ ∠D = 180° – 60° = 120°

But ∠DAP = 12 ∠A = 12 x 60° = 30°

∴∠DPA = 180° – (∠DAP + ∠D)

= 180° – (30° + 120°)

= 180° – 150° = 30°

∠DAP = ∠DPA (each = 30°)

Hence AD = DP (sides opposite to equal angles)

In Δ BCP,

∠ C = 60° (opposite to ∠ A)

∠CBP = 12 ∠ B = 12 x 120° = 60°

But ∠CPB + ∠CBP + ∠C = 180°

(Angles of a triangle)

=> ∠CPB + 60° + 60° = 180°

=> ∠CPB + 120° = 180°

=> ∠CPB = 180° – 120° = 60°

∆ CBP is an equilateral triangle and BC = CP = BP

=> PB – PC = BC

(iii) DC = DP + PC

= AD + BC

(∴ DP = AD and PC = BC proved)

= AD + AD (∴ AD = BC opposite sides of a ||gm)

= 2AD

Hence DC = 2AD.

Hence proved.

Question 4.

Solution:

In ||gm ABCD,

AC and BD are joined

∠BAO = 35°, ∠ DAO = 40°

∠COD = 105°

∴ ∠AOB = ∠COD

(vertically opposite angles)

∴ ∠AOB = 105°

(i) Now in Δ AOB,

∠ABO + ∠AOB + ∠OAB = 180°

(angles of a triangle)

=> ∠ABO + 105° + 35° = 180°

=> ∠ABO + 140° = 180°

=> ∠ABO = 180° – 140°

∠ ABO = 40°

(ii) ∴ AB || DC

∴ ∠ ABO = ∠ ODC (alternate angles)

∴ ∠ ODC = 40°

(iii) ∴ AD || BC

∴ ∠ ACB = ∠ DAO or ∠ DAC

(alternate angles)

= 40°

(iv) ∴ ∠ A + ∠ B = 180° (co-interior angles)

=> (40° + 35°) + ∠B = 180°

=> ∠B = 180° – 75° = 105°

=> ∠ CBD + ∠ABO = 105°

=> ∠CBD + 40° = 105°

=> ∠CBD = 105° – 40° = 65°

Hence ∠ CBD = 65° Ans.

Question 5.

Solution:

In ||gm ABCD

(∠A = (2x + 25)° and ∠ B = (3x – 5)°

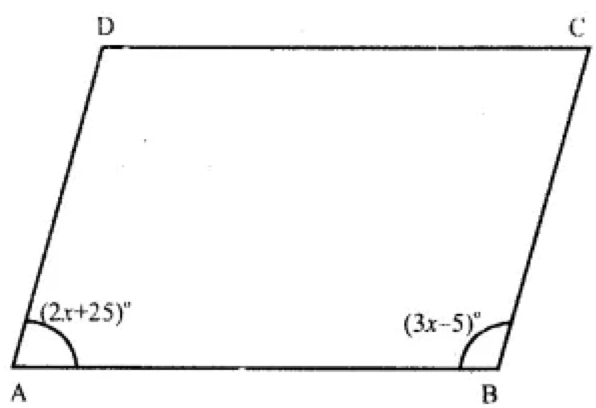
∴AD || BC (opposite sides of parallelogram)

∴∠ A + ∠B = 180° (co-interior angles)

=> 2x + 25° + 3x – 5° = 180°

=> 5x + 20° = 180°

=> 5x = 180° – 20°



=> 5x = 160° => x = 160o5 = 32°

∴x = 32°

Now ∠A = 2x + 25° = 2 x 32° + 25°

= 64° + 25° = 89°

∠B = 3x – 5 = 3 x 32° – 5°

= 96° – 5° = 91°

∠ C = ∠ A (∴ opposite angles of ||gm)

= 89°

Similarly ∠B = ∠D

∠D = 91°

Hence ∠ A = 89°, ∠ B = 91°, ∠ C = 89°, ∠D = 91° Ans.

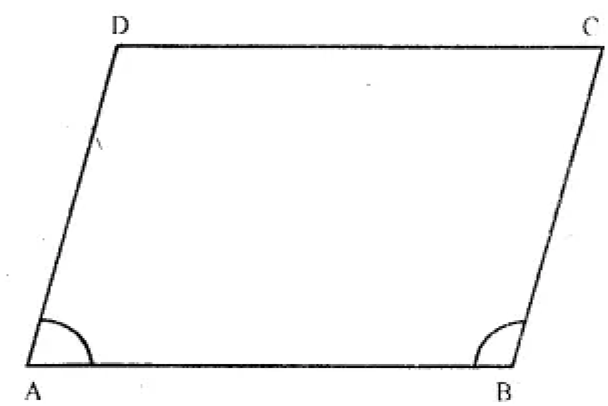
Question 6.

Solution:

Let ∠A and ∠B of a ||gm ABCD are adjacent angles.

∠A + ∠B = 180°

Let ∠B = x



Then ∠ A = 45 x

∴ x + 45 x = 180°

95 x = 180°

=>180oX59 = 100°

∴ ∠A = 45 x 100° = 80°

and ∠B = 100°

But ∠ C = ∠ A and ∠ D = ∠ B

(opposite angles of a || gm)

∴∠C = 80°, and ∠D = 100°

Hence ∠A = 80°, ∠B = 100°, ∠C = 80° and ∠ D = 100° Ans.

Question 7.

Solution:

Let the smallest angle ∠ A and the other angle ∠ B

Let ∠ A = x

Then ∠ B = 2x – 30°

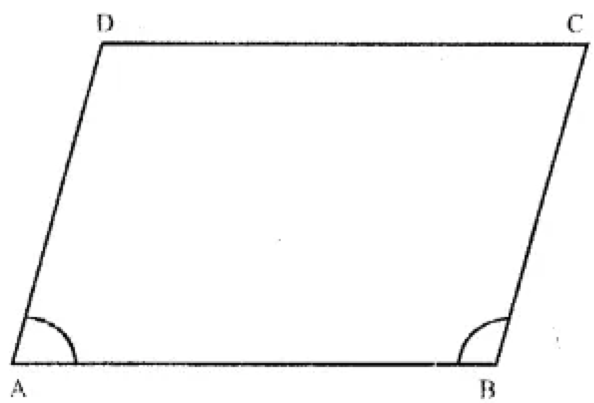
But ∠ A + ∠ B = 180° (co-interior angles)

∴x + 2x – 30° = 180°

=> 3x = 180° + 30° = 210°

=> x = 210o3 = 70°

∴ ∠ A = 70°



and ∠ B = 2x – 30° = 2 x 70° – 30°

= 140° – 30° = 110°

But ∠C = ∠ A and ∠D = ∠B

(opposite angles of a ||gm)

∠C = 70° and ∠D = 110°

Hence ∠A = 70°, ∠B = 110°, ∠C = 70° and ∠D = 110° Ans.

Question 8.

Solution:

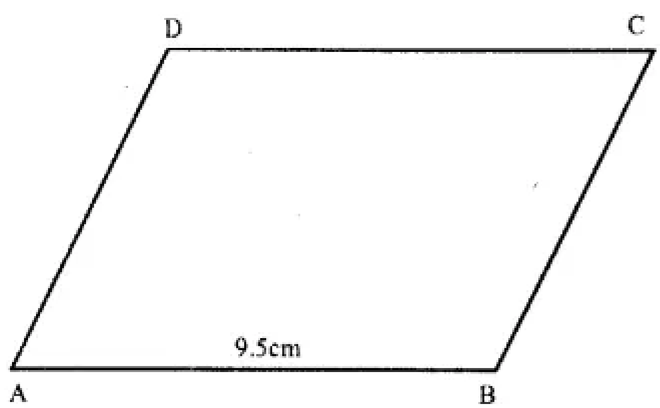
In ||gm ABCD,

AB = 9.5 cm and perimeter = 30 cm

=> AB + BC + CD + DA = 30cm

=> AB + BC + AB + BC = 30 cm

(∴ AB = CD and BC – DA opposite sides)



=> 2(AB + BC) = 30cm

=> AB + BC = 15cm

=> 9 5cm + BC = 15cm

∴BC = 15cm – 9.5cm = 5.5cm

Hence AB = 9.5cm, BC = 5.5cm,

CD = 9.5cm and DA = 5.5cm Ans.

Question 9.

Solution:

ABCD is a rhombus

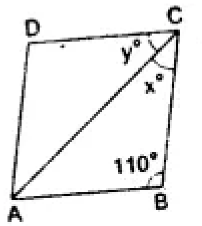
AB = BC = CD = DA

(i)∴ AB || DC

∴ ∠ B + ∠ C = 180° (co-interior angles)

=> 110° + ∠C = 180°

=> ∠C = 180° – 110° = 70°



(i)

$\because$ AC is the diagonal of rhombus ABCD

AC bisects $\angle C$

$\therefore$ $x^o = y^o$

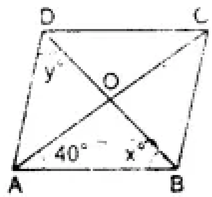
But $x^o + y^o = 70^o$

$x = y = 35^o$

(ii) $\because$ AC is the diagonal of rhombus ABCD

$\therefore$ AC bisects $\angle A$

$\therefore$ $\angle CAB = \frac{1}{2} \angle A$



(ii)

$\Rightarrow \quad \angle A = 2\angle CAB = 2 \times 40^{o} = 80^{o}$

Now in Δ ABD,

$\angle A + x^{o} + y^{o} = 180^{o}$ (Angles of a triangle)

$\Rightarrow \quad 80^{o} + x^{o} + y^{o} = 180^{o}$

$\Rightarrow \quad x^{o} + y^{o} = 180^{o} - 80^{o} = 100^{o}$

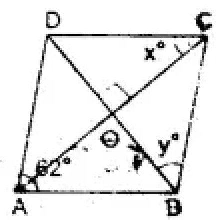
But $x^{o} = y^{o}$ $\qquad$ ($\because$ AB || AD)

$\therefore \quad x^{o} = y^{o} = \dfrac{100^{o}}{2} = 50^{o}$

(iii) ∵ diagonal AC of rhombus ABCD

bisects $\angle A$ and $\angle C$

and $\angle A = \angle C$ (opposite angles)



(iii)

$\therefore \quad x = \frac{1}{2} \angle C = \frac{1}{2} \angle A$

$= \frac{1}{2} \times 62^\circ = 31^\circ$

and $\angle A + \angle B = 180^\circ$ (co-interior angles)

$\Rightarrow \quad 62^\circ + \angle B = 180^\circ$

$\Rightarrow \quad \angle B = 180^\circ - 62^\circ$

Question 10.

Solution:

In a rhombus,

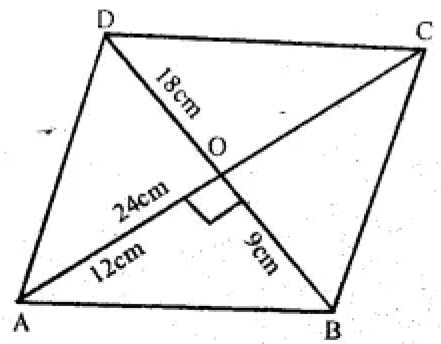
Diagonals bisect each other at right angles

∴ AC and BC bisect each other at O at right angles.

But AC = 24 cm and BD = 18 cm

$\therefore$ AO = OC = 12 cm ($\frac{1}{2}$ of AC)

and BO = OD = 9cm ($\frac{1}{2}$ of BD)



Now, in right Δ AOB,

$AB^2 = AO^2 + BO^2$ (Pythagoras Theorem)

$= (12)^2 + (9)^2$

$= 144 + 81 = 225 = (15)^2$

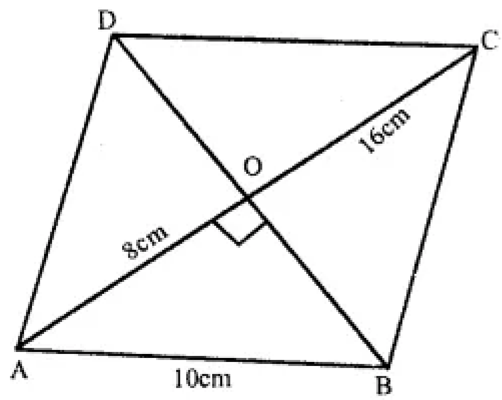
$\therefore$ AB = 15 cm

Hence each side of ABCD = 15 cm Ans.

Question 11.

Solution:

Let ABCD he the rhombus whose diagonal are AC and BD which bisect each other at right angles at O.



$\because$ AB = 10cm and AC = 16cm

$\therefore$ AO = OC = $\frac{16}{2}$ = 8cm.

Now, in right Δ AOB

$AB^2 = AO^2 + BO^2$ (Pythagoras Theorem)

$\Rightarrow (10)^2 = (8)^2 + BO^2$

$\Rightarrow 100 = 64 + BO^2$

$\Rightarrow BO^2 = 100 - 64 = 36$

$\Rightarrow BO^2 = 36 = (6)^2$

$\therefore$ BO = 6cm

But BD = 2BO = 2 × 6 = 12cm

Hence BD = 12cm

Now area of rhombus ABCD

$= \frac{1}{2} \times$ Product of diagonals

$= \frac{1}{2} \times AC \times BD$

$= \frac{1}{2} \times 16 \times 12 = 96\ cm^2$ Ans.

Question 12.

Solution:

ABCD is a rectangle whose diagonals AC and BD bisect each other at O.

(*i*) In fig (*i*), $\angle CAB = 30^o$

In ΔOAB,

$OA = OB$

$\therefore \angle OAB = \angle OBA$

But $\angle OAB$ or $\angle CAB = 35^o$

$\therefore \angle OBA = 35^o$

But $\angle CBA = 90^o$ (Angle of a rectangle)

$\Rightarrow \angle OBA + x = 90^o$

$\Rightarrow 35^o + x = 90^o$

$\Rightarrow x = 90^o - 35^o = 55^o$

$\therefore x = 55^o$

But $\angle OBA + \angle OAB + \angle AOB = 180^o$

(Angles of a triangle)

$\Rightarrow 35^o + 35^o + \angle AOB = 180^o$

$\Rightarrow 70^o + \angle AOB = 180^o$

$\Rightarrow \angle AOB = 180^o - 70^o = 110^o$

But $\angle COD = \angle AOB$ (Vertically opposite angles)

$\therefore \angle COD = 110^\circ$

or $y = 110^\circ$ Ans.

(*ii*) In rectangle ABCD,

$\angle AOB = 110^\circ$

$\angle C = 90^\circ$ (Angle of a rectangle)

$\Rightarrow x^\circ + y^\circ = 90^\circ$

$\because AB \parallel DC$ (opposite sides of rectangle)

$\therefore \angle OAB = \angle OCD = y^\circ$

But $OA = OB$

$\therefore \angle OBA = \angle OAB = y^\circ$

But $\angle OAB + \angle OBA + \angle AOB = 180^\circ$ (Angles of a triangle)

$\Rightarrow y^\circ + y^\circ + 110^\circ = 180^\circ$

$\Rightarrow 2y^\circ = 180^\circ - 110^\circ = 70^\circ$

$$\therefore y^\circ = \frac{70^\circ}{2} = 35^\circ$$

But $x^\circ + y^\circ = 90^\circ$

$\therefore x^\circ + 35^\circ = 90^\circ$

$\therefore x = 90^\circ - 35^\circ = 55^\circ$

Hence $x^\circ = 55^\circ$ and $y^\circ = 35^\circ$

Question 13.

Solution:

ABCD is a square. A line CX cuts AB at X and diagonal BD at O such that

∠ COD = 80° and ∠ OXA = x°

∴∠ BOX = ∠ COD

(vertically opposite angles)

∴∠BOX = 80°

∴Diagonal BD bisects ∠ B and ∠ D

∴ ∠ABO or ∠ABD = ∠ ADO or ∠ ADB

∴ ∠OBA or ∠OBX = 45°

Now in Δ OBX,

Ext. ∠ OXA = ∠ BOX + ∠ OBX

=>x° = 80° + 45° = 125° Ans.

Question 14.

Solution:

Given : In ||gm ABCD, AC is joined. AL ⊥ BD and CM ⊥ BD

To prove :

(i) Δ ALD ≅ Δ CMB

(ii) AL = CM

Proof : In Δ ALD and Δ BMC

AD = BC (opposite sides of ||gm)

∠L = ∠M (each 90°)

∠ ADL = ∠ CBM (Alternate angles)

∴ Δ ALD ≅ Δ BMC. (AAS axiom)

∴ or A ALD ≅ A CMB.

AL = CM (c.p.c.t.) Hence proved.

Question 15.

Solution:

Given : In Δ ABCD, bisectors of ∠A and ∠B meet each other at P.

To prove : ∠APB = 90°

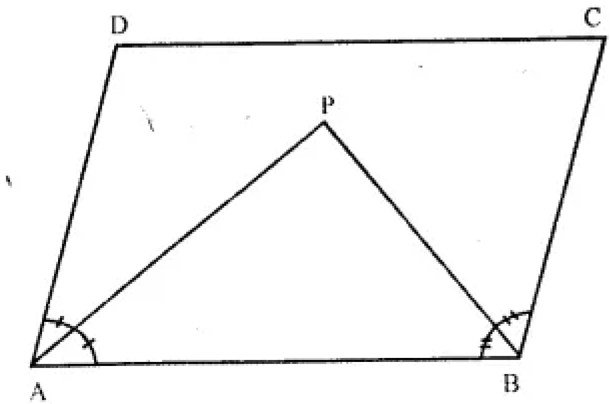
Proof : AD || BC

∠A + ∠B = .180° (co-interior angles)

PA and PB are the bisectors of ∠ A and ∠B

$\therefore \angle PAB = \frac{1}{2}\angle A$ and $\angle PBA = \frac{1}{2}\angle B$

$\therefore \angle PAB + \angle PBA = \frac{1}{2}\angle A + \frac{1}{2}\angle B$



$= \frac{1}{2}(\angle A + \angle B) = \frac{1}{2} \times 180^\circ = 90^\circ$

$= \frac{1}{2}(\angle A + \angle B) = \frac{1}{2} \times 180^\circ = 90^\circ$

But in Δ APB,

$\angle PAB + \angle PBA + \angle APB = 180^\circ$

(Angles of a triangle)

$\Rightarrow 90^\circ + \angle APB = 180^\circ$

$\Rightarrow \angle APB = 180^\circ - 90^\circ = 90^\circ$

Hence $\angle APB = 90^\circ$

Question 16.

Solution:

In ||gm ABCD,

P and Q are the points on AD and BC respectively such that AP = 13 AD and CQ = 13 BC

AQ and CP are joined.

To prove : AQCP is a ||gm.

Proof : ∵ ABCD is a ||gm

∴ AD || BC and AD = BC.

But $AP = \frac{1}{3}$ AD ...(i) (given)

and $CQ = \frac{1}{3}$ BC ...(ii) (given)

∴ AP = CQ.

and AP || CQ.

∴ AQCP is a ||gm. Hence proved.

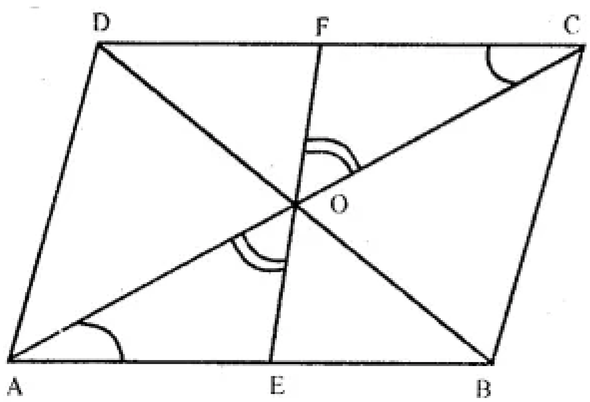
Question 17.

Solution:

Given : In ||gm ABCD, diagonals AC and BD bisect each other at O.

A line segment EOF is drawn, which meet AB at E and DC at F.

To -prove : OE = OF



Proof : In ΔAOE and ΔCOF,

$AO = OC$

(Diagonals bisect each other at O)

$\angle AOE = \angle COF$ (vertically opposite angles)

$\angle OAE = \angle OCF$ (alternate angles)

$\therefore \Delta AOE \cong \Delta COF$ (ASA axioms)

$\therefore OE = OF$ (c.p.c.t.) Hence proved.

Question 18.

Solution:

Given : ABCD is a ||gm.

AB is produced to E. Such that AB = BE

DE is joined which intersects BC in O.

To prove : ED bisects BC i.e. BO = OC

Proof : In Δ BOE and Δ COD,

BE = DC ($\because$ AB = BE and AB = DC)

$\angle$BOE = $\angle$COD,

(vertically opposite angles)

$\angle$DCO = $\angle$OBE (alternate angles)

$\therefore$ Δ BOE $\cong$ Δ COD (AAS axiom)

$\therefore$ BO = OC (c.p.c.t.)

Hence ED bisects BC.

Hence proved.

Question 19.

Solution:

Given : In ||gm ABCD, E is the midpoint BC

DE is joined and produced to meet AB on producing at F.

To prove : AF = 2AB.

Proof : In Δ BEF and CDE

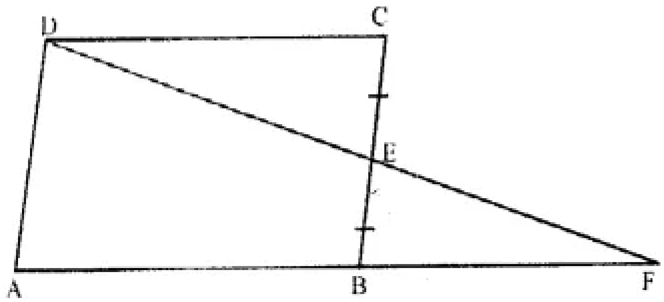
BE = EC ($\therefore$ E is mid point of BC)

$\angle$BEF = $\angle$CED
(vertically opposite angles)

$\angle$EBF = $\angle$DCE (alternate angles)

$\therefore$ ΔBEF $\cong$ ΔCDE (ASA axioms)

$\therefore$ BF = DC (c.p.c.t.)



But AB = DC (opposite sides of ||gm)

$\therefore$ BF = AB

$\therefore$ AF = AB + BF = AB + AB

Hence AF = 2AB

Hence proved.

Question 20.

Solution:

Given : Δ ABC and lines are drawn through A, B and C parallel to respectively BC, CA and AB forming Δ PQR.

To prove : BC = 12 QR

Proof : $\because$ RQ || BC and PR || AB

$\therefore$ ABCR is a ||gm

$\therefore$ BC = AR ...(i)

Similarly PQ || AC and QR || BC

$\therefore$ AQBC is another ||gm.

$\therefore$ AQ = BC ...(ii)

Adding (i) and (ii),

BC + BC = AR + AQ

$\Rightarrow$ 2BC = QR

$\Rightarrow BC = \frac{1}{2}QR$

Hence proved.

Question 21.

Solution:

Given : In $\triangle$ ABC, parallel lines are drawn through A, B and C respectively to the sides BC, CA and AB intersecting each other at P, Q and R.

To prove : Perimeter of Δ PQR

= 2 perimeter of Δ ABC

Proof : $\because$ QR $\parallel$ BC and PQ $\parallel$ AC

$\therefore$ ACBQ is a $\parallel$gm

$\therefore$ AQ = BC ...(i)

Similarly ABCR is a $\parallel$gm

$\therefore$ AR = BC ...(ii)

Adding (i) and (ii),

AQ + AR = BC + BC

$\Rightarrow$ QR = 2BC ...(iii)

Similarly, we prove that

PQ = 2AC ...(iv)

and PR = 2AB ...(v)

Adding (iii), (iv) and (v)

QR + PQ + PR = 2BC + 2AC + 2AB

PQ + QR + RP = 2(AB + BC + CA)

$\therefore$ Perimeter of Δ PQR = 2 perimeter of Δ ABC

Hence proved.

Ex 9C

Question 1.

Solution:

Given : In trapezium ABCD,

AB || DC and E is the midpoint of AD.

A line EF ||AB is drawn meeting BC at F.

To prove : F is midpoint of BC

Proof : $\because$ AB || EF || DC

$$\therefore \quad \frac{DE}{EA} = \frac{CF}{FB}$$

But DE = EA (D is mid-point of AD)

$$\Rightarrow \frac{DE}{EA} = 1$$

$$\therefore \frac{CF}{FB} = 1 \qquad \Rightarrow CF = FB$$

Hence F is mid point of BC.

Question 2.

Solution:

Given : In ||gm ABCD, E and F are the mid points of AB and CD respectively. A line segment GH is drawn which intersects AD, EF and BC at G, P and H respectively.

To prove : GP = PH

Proof : $\because$ AD || BC

(opposite sides of a ||gm)

E and F are the mid points of AB and DC respectively

$\therefore$ EF || AD || BC

$\because$ AD || EF || BC

$$\therefore \frac{AE}{EB} = \frac{GP}{PH}$$

But E is the mid point of AB

$\Rightarrow$ AE = EB

$$\Rightarrow \frac{AE}{EB} = 1$$

$$\therefore \frac{GP}{PH} = 1$$

$\Rightarrow$ GP = PH

Hence proved.

Question 3.

Solution:

Given : In trapezium ABCD, AB || DC

P, Q are the midpoints of sides AD and BC respectively

DQ is joined and produced to meet AB produced at E

Join AC which intersects PQ at R.

To prove : (i) DQ = QE

(ii) AR = RC

Proof : In trapezium ABCD,

AB || DC

∴ P and Q are the mid points of AD and CB respectively

∴ PQ || AB || DC.

(i) In Δ DAE,

PQ || AB or AE

∵ P is mid point of DA

∴ Q is mid point of DE

∴ DQ = QE

(ii) Again in Δ ACD,

PQ or PR || DC

and P is mid point of AD

∴ R is mid point of AC

Hence AR = RC.

Hence proved.

Question 4.

Solution:

Given : In Δ ABC,

AD is the mid point of BC

DE || AB is drawn. BE is joined.

To prove : BE is the median of Δ ABC.

Proof : In Δ ABC

D is the mid point of BC ($\because$ AC is median)
and DE || BA

$$\therefore \frac{BD}{DC} = \frac{AE}{EC}$$

But BD = DC

$$\Rightarrow \frac{BD}{DC} = 1$$

$$\therefore \frac{AE}{EC} = 1 \quad \Rightarrow AE = EC$$

$\therefore$ E is the mid point of AC.
Hence BE is the median of Δ ABC,
Hence proved.

Question 5.

Solution:

Given : In ∆ ABC, AD and BE are the medians. DF || BE is drawn meeting AC at F.

To prove : CF = 14 BC.

Proof : In Δ BEC

DF || BE

$\therefore \quad \frac{BD}{DC} = \frac{EF}{FC}$

But D is mid point of BC

$\therefore$ BD = DC

$\Rightarrow \frac{BD}{DC} = 1$

$\therefore \frac{EF}{FC} = 1$

$\Rightarrow$ EF = FC $\quad \Rightarrow CF = \frac{1}{2}$ EC

But E is mid point of AC

$\therefore EC = AE = \frac{1}{2}AC$

$\therefore CF = \frac{1}{2}(\frac{1}{2} AC) = \frac{1}{4} AC$

Hence proved.

Question 6.

Solution:

Given : In ||gm ABCD, E is mid point of DC.

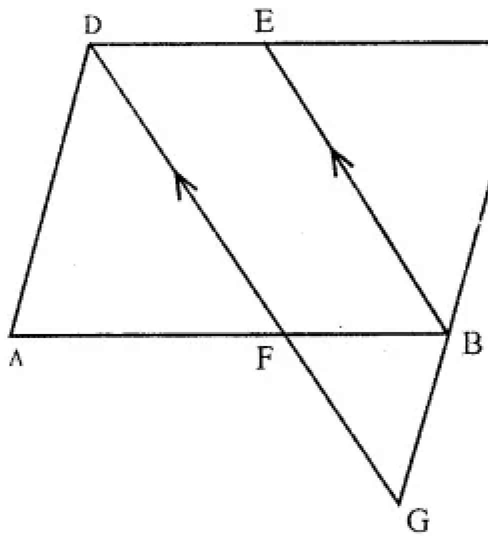
EB is joined and through D, DEG || EB is drawn which meets CB produced at G and cuts AB at F.

To prove : (i)AD = 12 GC

(ii) DG = 2EB

Proof : (i) In Δ CDG,

EB || DG



$$\therefore \quad \frac{CF}{ED} = \frac{CB}{BG}$$

But E is the mid point of CD

$\therefore \quad$ CF = EC

$$\Rightarrow \quad \frac{CE}{EC} = 1$$

$$\therefore \quad \frac{CB}{BG} = 1 \Rightarrow CB = BG$$

$$\therefore \quad CB = \frac{1}{2} GC$$

But AD = BC (opposite sides of a ||gm)

$$\Rightarrow \quad AD = \frac{1}{2} GC$$

But AD = BC (opposite sides of a ||gm)

$\Rightarrow \quad AD = \frac{1}{2}GC$

(ii) Again in Δ CDG,

EB || DG and E is mid point of DC

$\therefore \quad EB = \frac{1}{2} DG$

$\Rightarrow \quad DG = 2EB$

Hence proved.

But AD = BC (opposite sides of a ||gm)

$\Rightarrow \quad AD = \frac{1}{2}GC$

(ii) Again in Δ CDG,

EB || DG and E is mid point of DC

$\therefore \quad EB = \frac{1}{2} DG$

$\Rightarrow \quad DG = 2EB$

Hence proved.

Question 7.

Solution:

Given : In Δ ABC,

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

DE, EF and FD are joined.

To prove : $\Delta AEF \cong \Delta BDF$

$\cong \Delta DEF \cong \Delta CDE$

Proof : $\because$ D and E are the mid points of BC and CA respectively

$\therefore$ DE $\parallel$ AB and $DE = \frac{1}{2} AB$

Similarly D and F are the midpoints of BC and AB respectively

$\therefore$ DF $\parallel$ AC and $DF = \frac{1}{2} AC$

$\Rightarrow DF = AE = EC.$

Now in ΔAEF and ΔDEF,

AF = DE (proved)

AE = DF (proved)

EF = EF (common)

$\therefore \Delta AEF \cong \Delta DEF$ (SSS criteria)

$\therefore$ area (ΔAEF) = area (ΔDEF) ...(i)

Similarly, we can prove that

$\Delta BDF \cong \Delta DEF$ and $\Delta CDE \cong \Delta DEF$

$\therefore$ area (ΔBDF) = area (ΔDEF) ...(ii)

and area (ΔCDE) = area (ΔDEF) ...(iii)

from (i), (ii) and (iii)

area (ΔAEF) = area (ΔBDF) = area (ΔCDF) = area (ΔDEF)

Hence proved.

Question 8.

Solution:

Given : In Δ ABC, D, E and F are the mid points of sides BC, CA and AB respectively

To prove : ∠EDF = ∠A, ∠DEF = B
and ∠DFE = ∠C
Proof : ∵ D and E are the mid points of BC and CA respectively
∴ DE || AB.
Similarly, D and F are the mid points of BC and AB respectively
∴ DF || AC
∴ AFDE is a ||gm.
∴ ∠EDF = ∠A (opposite angles of a ||gm)
Similarly we can prove that
BDEF is a ||gm
∴ ∠DEF = ∠B
and DCEF is a ||gm
∴ ∠DFE = ∠C.
Hence proved.

Question 9.

Solution:

Given : In rectangle ABCD, P, Q, R and S are the midpoints of its sides AB, BC, CD and DA respectively PQ, QR, RS and SP are joined.

To prove : PQRS is a rhombus.

$\therefore$ SR || AC and SR = $\frac{1}{2}$ AC ...(ii)

From (i) and (ii),

PQ || SR and PQ = SR

$\therefore$ PQRS is a ||gm.

Now in Δ APS and Δ BPQ,

AP = PB (P is mid point of AB)

$\angle A = \angle B$ (each 90°)

AS = BQ (Half of equal sides)

$\therefore$ $\Delta APS \cong \Delta BPQ$. (SAS axiom)

$\therefore$ SP = PQ. (c.p.c.t.)

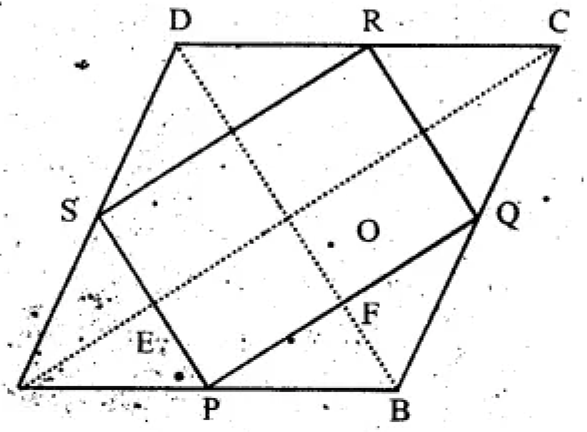
But these are adjacent sides of a ||gm PQRS

Hence PQRS is a rhombus.

Question 10.

Solution:

Given : In rhombus ABCD, P, Q, R and S are the mid points of sides AB, BC, CD and DA respectively PQ, QR, RS and SP are joined.



To prove : PQRS is a rectangle.

Const. Join AC.

Proof : In ΔABC,

$\because$ P and Q are the mid points of AB and respectively

Δ PQ || AC and $PQ = \frac{1}{2} AC$ ...(i)

Similarly, in Δ ADC,

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

$\therefore$ SR || AC and SR = $\frac{1}{2}$ AC ...(ii)

From (i) and (ii)

$\therefore$ PQ = SR and PQ || SR

$\therefore$ PQRS is a ||gm.

$\because$ PQ || SR || AC

and SA || BD || QR

$\therefore$ PEOF is a ||gm.

But $\angle O = 90^\circ$ ($\because$ diagonals of a rhombus bisect eachother at right angles)

$\therefore$ $\angle EPF = 90^\circ$ (opposite angles of a ||gm)

$\Rightarrow$ $\angle P = 90^\circ$

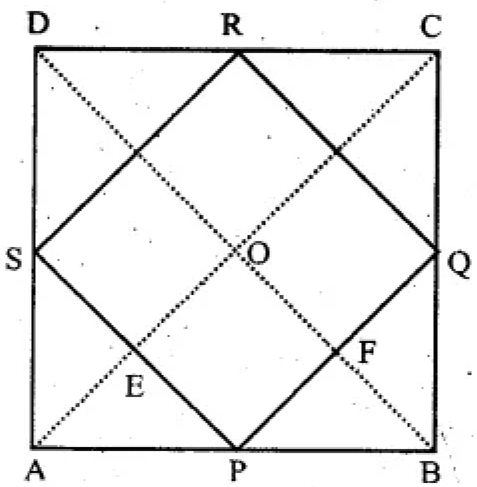
Hence PQRS is a rectangle.

Hence proved.

Question 11.

Solution:

Given : In square ABCD, P,Q,R and S are the mid points of sides AB, BC, CD and DA respectively. PQ, QR, RS and SP are joined.



To prove : PQRS is a square.

Const. Join AC.

Proof : In Δ ABC,

P and Q are the mid points of AB and BC

$\therefore$ OQ || AC and PQ = $\frac{1}{2}$ AC ...(i)

Similarly, in Δ ADC,

S and R are mid points of AD and DC

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

from (i) and (ii)

PQRS is a $\parallel$gm

Now in Δ ASP and Δ BQP,

AP = PB (P is mid point of AB)

$\angle A = \angle B$ (each $= 90^\circ$)

AS = BQ (Half of equal sides AD and BC)

$\therefore$ $\Delta ASP \cong \Delta BQP$ (SAS axiom)

$\therefore$ PS = PQ

$\therefore$ PQRS is a rhombus

Again $\because$ PQ $\parallel$ AC $\parallel$ SR

Similarly PS $\parallel$ BD $\parallel$ QR

$\therefore$ EPFO is a $\parallel$gm

$\therefore$ $\angle O = \angle P$ (opposite angles of $\parallel$gm)

But $\angle D = 90^\circ$ ($\because$ diagonals of a square bisect eachother at right angles)

$\therefore$ $\angle P = 90^\circ$

$\therefore$ PQRS is a square

Hence proved.

Question 12.

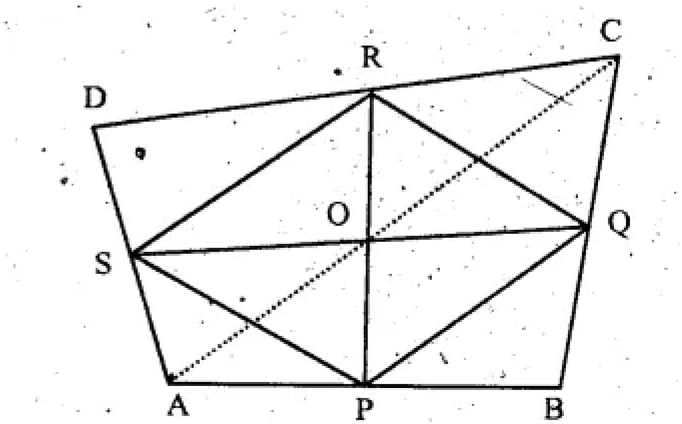
Solution:

Given : In quadrilateral ABCD, P, Q, R and S are the midpoints of PQ, QR, RS and SP respectively PR and QS are joined.

To prove : PR and QS bisect each other

Const. Join PQ, QR, RS and SP and AC

Proof : In Δ ABC,



P and Q are the midpoints of AB and BC.

$\therefore$ PQ || AC and $PQ = \frac{1}{2} AC$ ...(i)

Similarly, in Δ ADC,

S and R are the midpoints of AD and CD

$\therefore$ SR || AC and $SR = \frac{1}{2} AC$ ...(ii)

from (i) and (ii), PQRS is a ||gm.

But diagonals of a ||gm bisect each other PR and QS bisect each other.

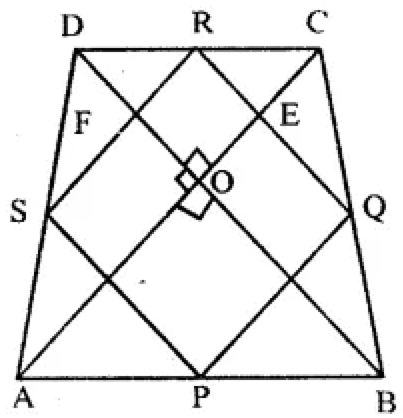
∴ PR and QS bisect each other

Question 13.

Solution:

Given : ABCD is a quadrilateral. Whose diagonals AC and BD intersect each other at O at right angles.

P, Q, R and S are the mid points of sides AB, BC, CD and DA respectively. PQ, QR, QS and SP are joined.



To prove : PQRS is a rectangle.

Proof : In Δ ABC,

P and Q are the midpoints of AB and BC

$\therefore$ PQ || AC and PQ = $\frac{1}{2}$ AC ...(i)

Similarly, in Δ ADC,

S and R the midpoints of AD and DC

$\therefore$ SR || AC and SR = $\frac{1}{2}$ AC ...(ii)

from (i) and (ii)

PQRS is a parallelogram.

$\because$ SR || AC and RQ || BD

$\therefore$ RFOE is a ||gm.

But $\angle$EOF = 90° ($\because$ diagonals AC and BD intersect eachother at right angles)

$\therefore$ $\angle$B = 90° (opposite angles of a ||gm)

$\therefore$ PQRS is a rectangle.

Hence proved.

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