









Parallelograms Exercise 16A

What is a Parallelogram?

- Opposite sides are parallel
- Opposite sides are congruent
- Opposite angles are equal
- Consecutive angles supplementary
- Diagonals bisect each other



Type	Properties
Parallelogram 	<ul style="list-style-type: none">• Opposite sides are equal and parallel• Opposite angles are equal
Rectangle 	<ul style="list-style-type: none">• Opposite sides are equal and parallel• All angles are right angles (90°)
Square 	<ul style="list-style-type: none">• Opposite sides are parallel• All sides are equal• All angles are right angles (90°)
Rhombus 	<ul style="list-style-type: none">• Opposite sides are parallel• All sides are equal• Opposite angles are equal• Diagonals bisect each other at right angles (90°)
Trapezoid 	<ul style="list-style-type: none">• One pair of opposite sides is parallel
Kite 	<ul style="list-style-type: none">• Two pairs of adjacent sides are equal• One pair of opposite sides are equal• One diagonal bisects the other• Diagonals intersect at right angle (90°)



Q1

Answer :

It is given that $ABCD$ is a parallelogram in which $\angle A$ is equal to 110° .

Sum of *the* adjacent angles of a parallelogram is 180° .

$$\begin{aligned}\therefore \angle A + \angle B &= 180^\circ \\ \Rightarrow 110^\circ + \angle B &= 180^\circ \\ \Rightarrow \angle B &= (180^\circ - 110^\circ) \\ \Rightarrow \angle B &= 70^\circ \\ \therefore \angle B &= 70^\circ\end{aligned}$$

Also, $\angle B + \angle C = 180^\circ$

$$\begin{aligned}\Rightarrow 70^\circ + \angle C &= 180^\circ \\ \Rightarrow \angle C &= (180^\circ - 70^\circ) \\ \Rightarrow \angle C &= 110^\circ \\ \therefore \angle C &= 110^\circ\end{aligned}$$

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

$$\begin{aligned}\Rightarrow 110^\circ + \angle D &= 180^\circ \\ \Rightarrow \angle D &= (180^\circ - 110^\circ) \\ \Rightarrow \angle D &= 70^\circ \\ \therefore \angle D &= 70^\circ\end{aligned}$$

Q2

Answer :

Let the required angle be x° .

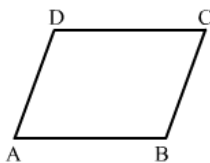
As the adjacent angles are equal, we have :

$$\begin{aligned}x + x &= 180 && (\text{since the sum of adjacent angles of a parallelogram is } 180^\circ) \\ \Rightarrow 2x &= 180 \\ \Rightarrow x &= \frac{180}{2} \\ \Rightarrow x &= 90^\circ\end{aligned}$$

Hence, the measure of each of the angles is 90° .

Q3

Answer :



Let $ABCD$ be the parallelogram.

Then, $\angle A$ and $\angle B$ are its adjacent angles.

Let $\angle A = (4x)^\circ$

$\angle B = (5x)^\circ$

$\therefore \angle A + \angle B = 180^\circ$ [since sum of *the* adjacent angles of a parallelogram is 180°]

$$\Rightarrow 4x + 5x = 180$$

$$\Rightarrow 9x = 180$$

$$\Rightarrow x = \frac{180}{9}$$

$$\Rightarrow x = 20$$

$$\therefore \angle A = (4 \times 20)^\circ = 80^\circ$$

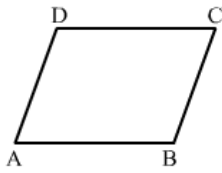
$$\angle B = (5 \times 20)^\circ = 100^\circ$$

Opposite angles of parallelogram are equal.

$$\therefore \angle C = \angle A = 80^\circ$$

$$\angle D = \angle B = 100^\circ$$

Q4



Let $ABCD$ be a parallelogram.

$$\text{Let } \angle A = (3x - 4)^\circ$$

$$\angle B = (3x + 16)^\circ$$

$$\therefore \angle A + \angle B = 180^\circ \quad [\text{since the sum of adjacent angles of a parallelogram is } 180^\circ]$$

$$\Rightarrow 3x - 4 + 3x + 16 = 180$$

$$\Rightarrow 3x - 4 + 3x + 16 = 180$$

$$\Rightarrow 6x + 12 = 180$$

$$\Rightarrow 6x = 168$$

$$\Rightarrow x = \frac{168}{6}$$

$$\Rightarrow x = 28$$

$$\therefore \angle A = (3 \times 28 - 4)^\circ$$

$$= (84 - 4)^\circ$$

$$= 80^\circ$$

$$\angle B = ((3 \times 28) + 16)^\circ$$

$$= (84 + 16)^\circ$$

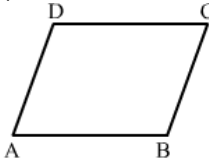
$$= 100^\circ$$

The opposite angles of a parallelogram are equal.

$$\therefore \angle C = \angle A = 80^\circ$$

$$\angle D = \angle B = 100^\circ$$

Q5



Let $ABCD$ be a parallelogram and let the sum of its opposite angles be 130° .

$$\angle A + \angle C = 130^\circ$$

The opposite angles are equal in a parallelogram.

$$\therefore \angle A = \angle C = x^\circ$$

$$\Rightarrow x + x = 130$$

$$\Rightarrow 2x = 130$$

$$\Rightarrow x = \frac{130}{2}$$

$$\Rightarrow x = 65$$

$$\therefore \angle A = 65^\circ \text{ and } \angle C = 65^\circ$$

$$\angle A + \angle B = 180^\circ \quad [\text{since the sum of adjacent angles of a parallelogram is } 180^\circ]$$

$$\Rightarrow 65^\circ + \angle B = 180^\circ$$

$$\Rightarrow \angle B = (180 - 65)^\circ$$

$$\Rightarrow \angle B = 115^\circ$$

$$\angle D = \angle B = 115^\circ \quad [\text{opposite angles of parallelogram are equal}]$$

Q6

Answer :

Let the lengths of two sides of the parallelogram be $5x$ cm and $3x$ cm, respectively.

$$\text{Then, its perimeter} = 2(5x + 3x) \text{ cm}$$

$$= 16x \text{ cm}$$

$$\therefore 16x = 64$$

$$\Rightarrow x = \frac{64}{16}$$

$$\Rightarrow x = 4$$

$$\therefore \text{One side} \Rightarrow (5 \times 4) \text{ cm} = 20 \text{ cm}$$

$$\text{Other side} \Rightarrow (3 \times 4) \text{ cm} = 12 \text{ cm}$$

Q7

Answer :

Let the lengths of two sides of the parallelogram be x cm and $(x + 10)$ cm, respectively.

$$\text{Then, its perimeter} = 2[x + (x + 10)] \text{ cm}$$

$$= 2[x + x + 10] \text{ cm}$$

$$= 2[2x + 10] \text{ cm}$$

$$= 4x + 20 \text{ cm}$$

$$4x + 20 = 140$$

$$\Rightarrow 4x = 140 - 20$$

$$\Rightarrow 4x = 120$$

$$\Rightarrow x = \frac{120}{4}$$

$$\Rightarrow x = 30$$

$$\text{Length of one side} = 30 \text{ cm}$$

$$\text{Length of the other side} \Rightarrow (30 + 10) \text{ cm} = 40 \text{ cm}$$

Q8



Answer :

Refer to the figure given in the book.

In $\triangle BMC$ and $\triangle DNA$:

$$\angle DNA = \angle BMC = 90^\circ$$

$$\angle BCM = \angle DAN \quad (\text{alternate angles})$$

$$BC = DA \quad (\text{opposite sides})$$

By AAS congruency criteria :

$$\triangle BMC \cong \triangle DNA$$

Yes, it is true that BM is equal to DN .

(by corresponding parts of congruent triangles BMC and DNA)

Q9

Refer to the figure of the book.

$$\angle A = \angle C \quad (\text{opposite angles of a parallelogram are equal})$$

$$\Rightarrow \frac{1}{2} \angle A = \frac{1}{2} \angle C$$

$$\Rightarrow \angle EAD = \angle FCB \quad (AE \text{ and } CF \text{ bisect the angles } A \text{ and } C, \text{ respectively})$$

In $\triangle ADE$ and $\triangle CBF$:

$$\angle B = \angle D \quad (\text{opposite angles of a parallelogram are equal})$$

$$\angle EAD = \angle FCB \quad (\text{proved above})$$

$$AD = BC \quad (\text{opposite sides of a parallelogram are equal})$$

By AAS congruency criteria :

$$\triangle ADE \cong \triangle CBF$$

$$DE = BF \quad (\text{corresponding parts of congruent triangles})$$

$$CD = AB \quad (\text{opposite sides of a parallelogram are equal})$$

$$\text{Also, } CD - DE = AB - BF$$

$$\Rightarrow CE = AF$$

$ABCD$ is a parallelogram.

$$\therefore CD \parallel AB \quad (\text{opposite sides of a parallelogram are parallel})$$

$$\Rightarrow CE \parallel AF$$

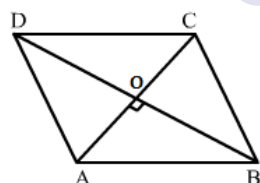
If one pair of sides of a quadrilateral is parallel and equal, then it is a parallelogram.

Therefore, $AECF$ is a parallelogram.

$$\therefore AE \parallel CF$$

Q10

Answer :



Let $ABCD$ be a rhombus.

Let AC and BD be the diagonals of the rhombus intersecting at a point O .

Let $AC = 16$ cm

$BD = 12$ cm

We know that the diagonals of a rhombus bisect each other at right angles.

$$\therefore AO = \frac{1}{2} AC$$

$$= \left(\frac{1}{2} \times 16 \right) \text{ cm}$$

$$= 8 \text{ cm}$$

$$BO = \frac{1}{2} BD$$

$$= \left(\frac{1}{2} \times 12 \right) \text{ cm}$$

$$= 6 \text{ cm}$$



From the right $\triangle AOB$:

$$\begin{aligned} AB^2 &= AO^2 + BO^2 \\ &= \{(8)^2 + (6)^2\} \text{ cm}^2 \\ &= (64 + 36) \text{ cm}^2 \\ &= 100 \text{ cm}^2 \\ \Rightarrow AB &= \sqrt{100} \text{ cm} \\ &= 10 \text{ cm} \end{aligned}$$

Hence, the length of the side AB is 10 cm.

$$AB = BC = CD = DA = 10 \text{ cm} \quad (\text{all sides of a rhombus are equal})$$

Q11

Answer :

Refer to the figure given in the book.

In $\triangle ADC$:

$$DA = DC \quad (\text{all sides of a square are equal})$$

$$\Rightarrow \angle ACD = \angle CAD$$

$$\text{Let } \angle ACD = \angle CAD = x^\circ \quad [\text{Angle opposite to the equal sides are equal}]$$

$$x + x + 90 = 180 \quad [\text{since the sum of the angles of a triangle is } 180^\circ]$$

$$\Rightarrow 2x + 90 = 180$$

$$\Rightarrow 2x = 90$$

$$\Rightarrow x = \frac{90}{2}$$

$$\Rightarrow x = 45$$

$$\therefore \angle CAD = 45^\circ$$

Q12

Answer :

Let the length of two sides of the rectangle be $5x$ cm and $4x$ cm, respectively.

$$\begin{aligned} \text{Then, its perimeter} &= 2(5x + 4x) \text{ cm} \\ &= 18x \text{ cm} \end{aligned}$$

$$\therefore 18x = 90$$

$$\Rightarrow x = \frac{90}{18}$$

$$\Rightarrow x = 5$$

$$\text{Length of one side} \Rightarrow (5 \times 5) \text{ cm} = 25 \text{ cm}$$

$$\text{Length of the other side} \Rightarrow (4 \times 5) \text{ cm} = 20 \text{ cm}$$

$$\therefore \text{Length of the rectangle} = 25 \text{ cm}$$

$$\text{Breadth} = 20 \text{ cm}$$

Q13

Answer :

(i) The diagonals are equal and the adjacent sides are unequal.

Hence, the given parallelogram is a rectangle.

(ii) The diagonals are equal and the adjacent sides are equal.

Hence, the given parallelogram is a square.

(iii) The diagonals are unequal and the adjacent sides are equal.

Hence, the given parallelogram is a rhombus.

(iv) All the sides are equal and one angle is 60° .

Hence, the given parallelogram is a rhombus.

(v) All the sides are equal and one angle is 90° .

Hence, the given parallelogram is a square.

(vi) All the angles are equal and the adjacent sides are unequal.

Hence, the given parallelogram is a rectangle.

Q14



Answer :

(i) The given statement is false.

The diagonals of a parallelogram bisect each other, but they are not equal in length.

(ii) The given statement is false.

The diagonals of a rectangle are equal and bisect each other, but they are not perpendicular.

(iii) The given statement is false.

All the sides of a rhombus are equal, but the diagonals are not equal.

(iv) The given statement is true.

(v) The given statement is false.

Every square is a rectangle, but every rectangle is not a square.

(vi) The given statement is true.

(vii) The given statement is true.

(viii) The given statement is true.

(ix) The given statement is false.

A rectangle is a special type of parallelogram, but every parallelogram is not a rectangle.

(x) The given statement is true.



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Parallelograms Exercise 16B

Q1

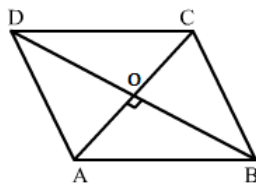
Answer :

(c) rhombus

In a rhombus, the two diagonals are not necessarily equal.

Q2

(c) 10 cm

Let $ABCD$ be a rhombus.Let AC and BD be the diagonals of the rhombus intersecting at a point O . $AC = 16$ cm $BD = 12$ cm

We know that the diagonals of a rhombus bisect each other at right angles.

$$\therefore AO = \frac{1}{2} AC$$

$$= \left(\frac{1}{2} \times 16 \right) \text{ cm}$$

$$= 8 \text{ cm}$$

$$BO = \frac{1}{2} BD$$

$$= \left(\frac{1}{2} \times 12 \right) \text{ cm}$$

$$= 6 \text{ cm}$$

From the right $\triangle AOB$:

$$AB^2 = AO^2 + BO^2$$

$$= \{(8)^2 + (6)^2\} \text{ cm}^2$$

$$= (64 + 36) \text{ cm}^2$$

$$= 100 \text{ cm}^2$$

$$\Rightarrow AB = \sqrt{100} \text{ cm}$$

$$= 10 \text{ cm}$$

Hence, the length of the side AB is 10 cm.

Therefore, the length of each side of the rhombus is 10 cm because all the sides of a rhombus are equal.

Q3

Answer :

(b) 32

We know that the sum of adjacent angles of a parallelogram is 180° .

$$\Rightarrow 2x + 25 + 3x - 5 = 180$$

$$\Rightarrow 5x + 20 = 180$$

$$\Rightarrow 5x = 180 - 20$$

$$\Rightarrow 5x = 160$$

$$\Rightarrow x = \frac{160}{5}$$

$$\Rightarrow x = 32$$

Therefore, the value of x is 32.

Q4

Answer :

(a) parallelogram

In a parallelogram, the diagonals do not necessarily intersect at right angles.

Q5



(c) 70 cm

Let $ABCD$ be a rectangle and let the diagonal AC be 25 cm, length AB be $4x$ cm and breadth BC be $3x$ cm.

Each angle of a rectangle is a right angle.

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

From the right $\triangle ABC$:

$$AC^2 = AB^2 + BC^2$$

$$\Rightarrow (25)^2 = (4x)^2 + (3x)^2$$

$$\Rightarrow 625 = 16x^2 + 9x^2$$

$$\Rightarrow 625 = 25x^2$$

$$x^2 = \frac{625}{25} = 25$$

$$\Rightarrow x = 5$$

$$\therefore \text{Length} = 4 \times 5 = 20 \text{ cm}$$

$$\text{Breadth} = 3 \times 5 = 15 \text{ cm}$$

$$\begin{aligned} \text{Q6} \quad \therefore \text{Perimeter of the rectangle} &= 2(20+15) \text{ cm} \\ &= 70 \text{ cm} \end{aligned}$$

Answer :

(d) 90°

The bisectors of any two adjacent angles of a parallelogram intersect at 90° .

Q7

Answer :

(b) 72°

Let x° be the angle of the parallelogram.

Sum of the adjacent angles of a parallelogram is 180° .

$$\therefore x + \left(\frac{2}{3} \times x\right) = 180$$

$$\Rightarrow x + \frac{2x}{3} = 180$$

$$\Rightarrow \left(x + \frac{2x}{3}\right) = 180$$

$$\Rightarrow \frac{5x}{3} = 180$$

$$\Rightarrow x = \left(180 \times \frac{3}{5}\right)$$

$$\Rightarrow x = 108$$

Hence, one angle of the parallelogram is 108° .

Its adjacent angle = $(180 - 108)^\circ = 72^\circ$

Therefore, the smallest angle of the parallelogram is 72° .

Q8

Answer :

(a) rectangle

In a rectangle, the diagonals do not necessarily bisect the interior angles at the vertices.

Q9

Q10

Answer :

(d) 8

All the sides of a square are equal.

$$\therefore AB = BC$$

$$\Rightarrow 2x + 3 = 3x - 5$$

$$\Rightarrow 3 + 5 = 3x - 2x$$

$$\Rightarrow 8 = x$$

Therefore, the value of x is 8.

Answer :

(c) 112°

Let x° be the smallest angle of the parallelogram.

The sum of adjacent angles of a parallelogram is 180° .

$$\therefore x + 2x - 24 = 180$$

$$\Rightarrow 3x - 24 = 180$$

$$\Rightarrow 3x = 180 + 24$$

$$\Rightarrow 3x = 204$$

$$\Rightarrow x = \frac{204}{3}$$

$$\Rightarrow x = 68$$

\therefore Smallest angle = 68°

Largest angle = $(180 - 68)^\circ = 112^\circ$