

In $\triangle OED$ and $\triangle OEA$, we have:

$$OA = OD \quad (\text{by above})$$

$$OE = OE \quad (\text{common})$$

$$AE = ED \quad (\text{By construction})$$

$\therefore \triangle OED \cong \triangle OEA$ (By SSS)

Now

$$\angle AOD = \angle BOC = 56^\circ \quad (\text{vertically opposite angles})$$

$$\text{As } \angle EOD = \angle EOA \quad (\text{CPCT})$$

$$\text{Also } \angle EOD + \angle EOA = 56^\circ$$

$$\therefore \angle EOD = 28^\circ$$

Similarly,

$$\angle OED = \angle OEA = 90^\circ$$

$$\text{Now in } \triangle OED, \angle OED + \angle EDO + \angle DOE = 180^\circ$$

$$\Rightarrow 90^\circ + \angle EDO + 28^\circ = 180^\circ$$

$$\Rightarrow \angle EDO = 62^\circ$$

$$\text{Thus, } \angle ADO = 62^\circ.$$

22. Fill in the blanks :

- (i) Quadrilaterals with each angle equal to 90° are known as _____ or _____.
- (ii) Quadrilaterals which have all sides equal are _____ or _____.
- (iii) _____ and _____ are the quadrilaterals which have opposite sides parallel.
- (iv) A quadrilateral with two pairs of adjacent sides equal is called a _____.
- (v) A four sided figure with one pair of parallel sides is called a _____.
- (vi) Diagonals of a rhombus are _____ to each other.
- (vii) Diagonals of a rhombus divide it into two _____ triangles.
- (viii) _____ is the only quadrilateral which has its sides perpendicular as well as diagonals perpendicular to each other.

Solution:

(i) Quadrilaterals with each angle equal to 90° are known as rectangle or square.

(ii) Quadrilaterals which have all sides equal are square or rhombus.

(iii) Parallelogram and rhombus are the quadrilaterals which have opposite sides parallel.

(iv) A quadrilateral with two pairs of adjacent sides equal is called a kite.

(v) A four sided figure with one pair of parallel sides is called a trapezium.

(vi) Diagonals of a rhombus are perpendicular bisector to each other.

(vii) Diagonals of a rhombus divide it into two right angled triangle.

(viii) Square is the only quadrilateral which has its sides perpendicular as well as diagonals perpendicular to each other.

23. Write True or False :

- (i) Every rhombus is a square.
- (ii) Every square is a rectangle.
- (iii) Every kite is a parallelogram.
- (iv) Every rhombus is not a parallelogram.
- (v) In a rhombus, the diagonals are not equal in length.
- (vi) Diagonals divide every quadrilateral in congruent triangles.
- (vii) Sum of the angles of a concave quadrilateral is 360° .
- (viii) Every parallelogram is a trapezium but every trapezium is not a parallelogram.
- (ix) The diagonals of a kite are perpendicular to each other.
- (x) Sum of the opposite angles of a parallelogram is 180° .

(i) False

A rhombus is a square only if each angle is equal to 90° .

(ii) True

(iii) False

In a kite two adjacent sides are equal
where as in parallelogram opposite sides
are equal.

(iv) False

Rhombus is a parallelogram.

(v) True

(vi) False

This is true for only parallelograms,
rhombus & rectangle.

(vii) True

(viii) True

(ix) True

(x) False

Opposite angles of a parallelogram are equal.



MISCELLANEOUS EXERCISE

1. A quadrilateral has three acute angles, each measuring 75° . Find its fourth angle.

Solution:

Sum of the interior angles of the quadrilateral $= 360^\circ$.

$$\begin{aligned}\text{Sum of three acute angles} &= 3 \times 75^\circ \\ &= 225^\circ\end{aligned}$$

$$\begin{aligned}\therefore \text{Measure of fourth angle} &= 360^\circ - 225^\circ \\ &= 135^\circ.\end{aligned}$$

2. One angle of a quadrilateral is 120° and the other three angles are equal. Find the measure of the other three angles.

Solution:

$$\begin{aligned}\text{Sum of the three angles} \\ &= 360^\circ - 120^\circ = 240^\circ\end{aligned}$$

$$\begin{aligned}\therefore \text{Measure of each angle} &= \frac{240^\circ}{3} \\ &= 80^\circ.\end{aligned}$$

3. The angles of a quadrilateral are in the ratio of 2 : 3 : 3 : 4. Find the angles of the quadrilateral.

Solution:

Let the angles have the measures $2x^\circ$, $3x^\circ$, $3x^\circ$ and $4x^\circ$.

Then,

$$2x^\circ + 3x^\circ + 3x^\circ + 4x^\circ = 12x^\circ$$

$$12x^\circ = 360^\circ$$

$$x^\circ = \frac{360^\circ}{12} = 30^\circ$$

Thus,

$$\text{Measure of } 2x^\circ = 2 \times 30^\circ = 60^\circ$$

$$\text{Measure of } 3x^\circ = 3 \times 30^\circ = 90^\circ$$

$$\text{Measure of } 3x^\circ = 3 \times 30^\circ = 90^\circ$$

$$\text{Measure of } 4x^\circ = 4 \times 30^\circ = 120^\circ$$

4. ABCD is a trapezium such that $AB \parallel CD$. $\angle A : \angle D = 7 : 2$, $\angle B : \angle C = 4 : 5$. Find the angles of the trapezium.

Solution:

We have

$$\angle A : \angle B : \angle C : \angle D = 7 : 4 : 5 : 2$$

$$\text{and } \angle A + \angle B + \angle C + \angle D = 360^\circ$$

Now,

let the angles of the measures $7x^\circ$, $4x^\circ$, $5x^\circ$ and $2x^\circ$.

Then,

$$7x^\circ + 4x^\circ + 5x^\circ + 2x^\circ = 360^\circ$$

$$18x^\circ = 360^\circ$$

$$x^\circ = \frac{360^\circ}{18} = 20^\circ$$

Thus,

$$\text{Measure of } 7x^\circ = 7 \times 20^\circ = 140^\circ$$

$$\text{Measure of } 4x^\circ = 4 \times 20^\circ = 80^\circ$$

$$\text{Measure of } 5x^\circ = 5 \times 20^\circ = 100^\circ$$

$$\text{Measure of } 2x^\circ = 2 \times 20^\circ = 40^\circ$$

$$\text{Hence, } \angle A = 7x^\circ = 140^\circ$$

$$\angle B = 4x^\circ = 80^\circ$$

$$\angle C = 5x^\circ = 100^\circ$$

$$\angle D = 2x^\circ = 40^\circ$$

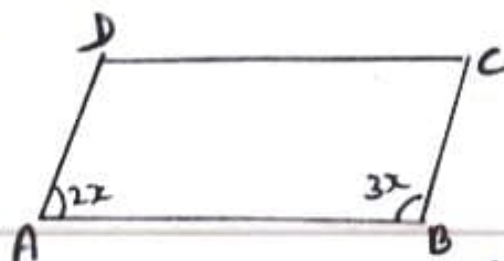
5. The adjacent angles of a parallelogram are in the ratio 2 : 3. Find the angles.

Solution:

Sum of adjacent angles in a Parallelogram = 180° .

$$\angle A : \angle B = 2 : 3$$

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Thus;

let the measure of adjacent angles be $2x^\circ$ and $3x^\circ$.

$$2x^\circ + 3x^\circ = 180^\circ$$

$$5x^\circ = 180^\circ$$

$$x^\circ = \frac{180^\circ}{5} = 36^\circ$$

$$\therefore 2x^\circ = 2 \times 36^\circ = 72^\circ$$

$$\text{and } 3x^\circ = 3 \times 36^\circ = 108^\circ$$

In parallelogram opposite angles are equal.
Hence, required measure of angles are

$$72^\circ, 108^\circ, 72^\circ, 108^\circ.$$

6. One angle of a parallelogram is 70° . Find the other angles of the parallelogram.

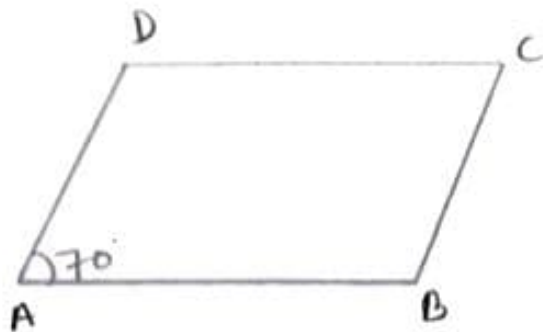
Solution:

In parallelogram,
opposite angles are equal.

$$\therefore \angle A = \angle C = 70^\circ.$$

$$\angle B = 180^\circ - 70^\circ = 110^\circ$$

$$\angle D = \angle B = 110^\circ.$$



(adjacent angles)

Hence, the other angles are 110° , 70° and 110° respectively.

7. One side of a parallelogram is 4.8 cm and the other side is $1\frac{1}{2}$ times of this side. Find the perimeter of the parallelogram.

Solution:

In parallelogram, opposite sides are equal.

Thus

$$BC = AD = 4.8 \text{ cm}$$

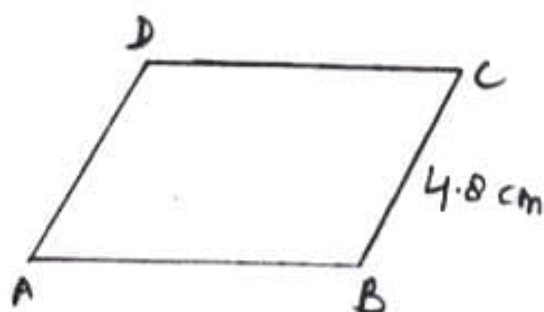
$$AB = 1\frac{1}{2} \text{ times of } BC$$

$$= \frac{3}{2} \times 4.8 = 7.2$$

$$\Rightarrow AB = CD = 7.2 \text{ cm}$$

$$\begin{aligned} \text{Perimeter of a parallelogram} &= AB + BC + CD + DA \\ &= 7.2 \text{ cm} + 4.8 \text{ cm} + \\ &\quad 7.2 \text{ cm} + 4.8 \text{ cm} \\ &= 24 \text{ cm.} \end{aligned}$$

Hence, perimeter of a parallelogram is 24 cm.



8. ABCD is a rhombus. Diagonals AC and BD bisect each other at point O such that AC = 6 cm, and BD = 8 cm. Find the side of the rhombus.

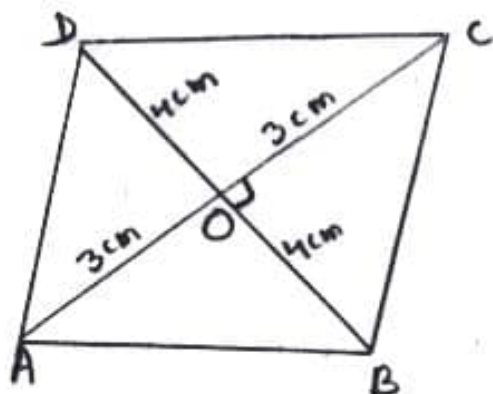
Solution:

In a rhombus, both diagonals bisect each other at right angles.

From figure, we have:

$$AO = 3 \text{ cm}$$

$$OB = 4 \text{ cm}$$



$$\therefore AB = \sqrt{(AO)^2 + (OB)^2}$$

$$= \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = 5$$

$$\therefore AB = 5 \text{ cm}$$

In rhombus, all sides are equal.

Thus, side of the rhombus is 5 cm.

9. Diagonals of a rhombus are equal. Is this rhombus also a square?

Solution:

Yes, when the diagonals are equal in measure and perpendicular bisector to each other. Then, this rhombus is also a square.

10. ABCD is a rectangle, its adjacent sides are in the ratio 3 : 5 and its perimeter is 48 cm. Find the length of the sides.

Solution:

Let the breadth of the rectangle be $3x$
and length be $5x$ respectively.

Then,

$$\begin{aligned}\text{Perimeter} &= 2(l + b) \\ &= 2(5x + 3x)\end{aligned}$$

Given that,

$$\text{Perimeter of a rectangle} = 48 \text{ cm}$$

\Rightarrow

$$2(5x + 3x) = 48 \text{ cm}$$

$$\Rightarrow 2 \times 8x = 48 \text{ cm}$$

$$\Rightarrow 16x = 48 \text{ cm}$$

$$x = \frac{48 \text{ cm}}{16} = 3 \text{ cm}$$

$$\therefore \text{Length} = 5x = 15 \text{ cm}$$

$$\text{Breadth} = 3x = 9 \text{ cm}.$$



MULTIPLE CHOICE QUESTIONS.

Tick (✓) the correct option :

1. The number of sides of a regular polygon whose each exterior angle has a measure of 45° , is :
(a) 5 (b) 6 (c) 7 (d) 8

Solution (d):

For a regular polygon of n -sides

$$n = \frac{360^\circ}{\text{Each exterior angle}} = \frac{360^\circ}{45^\circ} = 8$$

2. If the measure of each exterior angle of a regular polygon is 24° , then the polygon has :
(a) 8 sides (b) 10 sides (c) 15 sides (d) 18 sides

Solution (c):

$$\begin{aligned} \text{Number of sides} &= \frac{360^\circ}{\text{Each exterior angle}} \\ &= \frac{360^\circ}{24^\circ} = 15 \end{aligned}$$

3. In case of a convex quadrilateral, the measure of each angle is :
(a) equal to 180° (b) more than 180° (c) less than 180° (d) none of these

Solution (c):

In a convex quadrilateral, measure of each angle is less than 180° .

4. If the sides of a quadrilateral are produced in order, the sum of the four exterior angles so formed is :

(a) 180°

(b) 360°

(c) 270°

(d) 540°

Solution (b):

The sum of all exterior angles of a quadrilateral is 360° .

5. The angles of a quadrilateral are in the ratio 1 : 2 : 3 : 4. The largest angle is :

(a) 36°

(b) 72°

(c) 108°

(d) 144°

Solution (d):

Let the measure of the angles be $1x^\circ$, $2x^\circ$, $3x^\circ$ and $4x^\circ$.

$$\text{Thus, } 1x^\circ + 2x^\circ + 3x^\circ + 4x^\circ = 360^\circ$$

$$10x^\circ = 360^\circ$$

$$x^\circ = \frac{360^\circ}{10} = 36^\circ$$

$$\therefore \text{Measure of largest angle} = 4x^\circ = 4 \times 36^\circ = 144^\circ$$

6. If the angles of a quadrilateral are x° , $(x - 10)^\circ$, $(x + 30)^\circ$ and $2x^\circ$, then the greatest angle is :

(a) 136°

(b) 180°

(c) 68°

(d) 148°

Solution (a):

The sum of the four interior angles in a quadrilateral is 360° .

Thus,

$$x^\circ + (x-10)^\circ + (x+30)^\circ + 2x^\circ = 360^\circ$$

$$x^\circ + x^\circ - 10^\circ + x^\circ + 30^\circ + 2x^\circ = 360^\circ$$

$$5x^\circ + 20^\circ = 360^\circ$$

$$5x^\circ = 360^\circ - 20^\circ = 340^\circ$$

$$x^\circ = \frac{340^\circ}{5} = 68^\circ$$

\therefore Measure of angles are:

$$x^\circ = 68^\circ$$

$$(x-10)^\circ = (68-10)^\circ = 58^\circ$$

$$(x+30)^\circ = (68^\circ+30)^\circ = 98^\circ$$

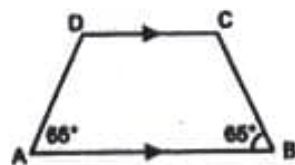
$$2x^\circ = 2 \times 68^\circ = 136^\circ$$

Hence, the greatest angle is 136° .

7. In the figure, the measure of $\angle C$ is :

- (a) 65°
(c) 135°

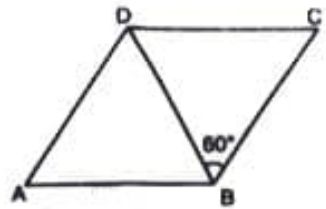
- (b) 115°
(d) 125°



Solution (b):

$$\text{Measure of } \angle C = 180^\circ - 65^\circ = 115^\circ$$

8. In the figure, ABCD is a parallelogram in which $\angle DBC = 60^\circ$. The measure of $\angle ADB$ is :
- (a) 45° (b) 60°
(c) 75° (d) 55°



Solution (b)

In a parallelogram alternate angles are equal.

Here $\angle ADB = \angle DBC$ (Alternate angles)

$$\therefore \angle ADB = 60^\circ.$$

9. A quadrilateral having only one pair of opposite sides parallel is called :
- (a) square (b) rhombus (c) trapezium (d) parallelogram

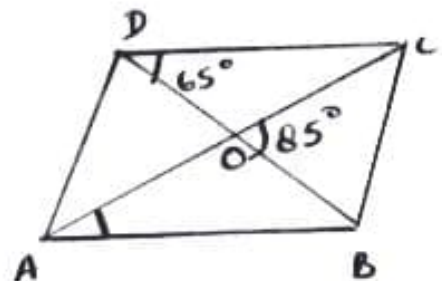
Solution (c)

A quadrilateral having only one pair of opposite sides parallel is called trapezium.

10. The diagonals of a parallelogram ABCD intersect at O. If $\angle BOC = 85^\circ$ and $\angle BDC = 65^\circ$, then $\angle OAB$ is :
- (a) 10° (b) 20° (c) 40° (d) 95°

Solution (b)

$$\begin{aligned} \angle DOC &= 180^\circ - 85^\circ \\ &= 95^\circ \end{aligned}$$



In $\triangle DOC$,

$$\angle ODC + \angle DOC + \angle DCO = 180^\circ$$

$$65^\circ + 95^\circ + \angle DCO = 180^\circ$$

$$\begin{aligned}\angle DCO &= 180^\circ - (65^\circ + 95^\circ) \\ &= 20^\circ\end{aligned}$$

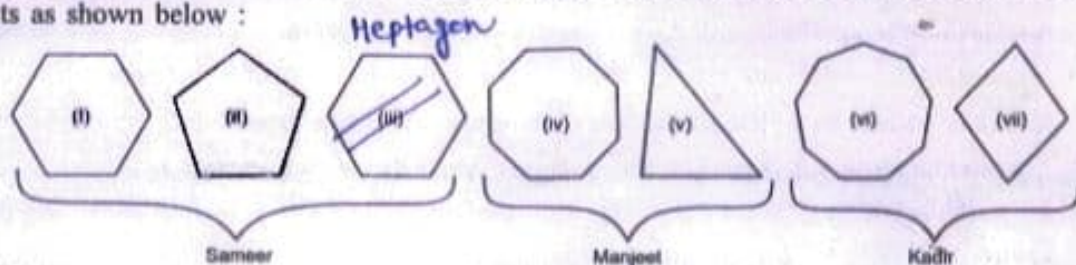
$\therefore \angle OAB = \angle DCO$ (Alternate angles)

$$\Rightarrow \angle OAB = 20^\circ.$$



VALUE BASED QUESTIONS.

Three boys Sameer, Manjeet and Kadir study in the same class. They are good friends too. They usually play together and share their toys and things with each other. They have some cardboard cutouts as shown below :



- Write the name of the shapes each boy has.
- Find the sum of the interior angles of each shape.
- How many diagonals does each shape have?
- By sharing their toys with each other, what qualities do these boys show?

Solution:

- (i) Hexagon
- (ii) Pentagon
- (iii) Heptagon

(iv) Octagon

(v) Triangle

(vi) Nonagon

(vii) Quadrilateral.

(b)

Sum of the angles of a polygon of n -sides
 $= (2n-4)$ right angles.

Thus,

(i) Here $n=6$

$$\text{Sum} = (2 \times 6 - 4) \times 90^\circ = 720^\circ$$

(ii) Here $n=5$

$$\text{Sum} = (2 \times 5 - 4) \times 90^\circ = 540^\circ$$

(iii) Here $n=7$

$$\text{Sum} = (2 \times 7 - 4) \times 90^\circ = 900^\circ$$

(iv) Here $n=8$

$$\text{Sum} = (2 \times 8 - 4) \times 90^\circ = 1080^\circ$$

(v) Here $n = 3$

$$\text{Sum} = (2 \times 3 - 4) \times 90^\circ = 180^\circ$$

(vi) Here $n = 9$

$$\text{Sum} = (2 \times 9 - 4) \times 90^\circ = 1260^\circ$$

(vii) Here $n = 4$

$$\text{Sum} = (2 \times 4 - 4) \times 90^\circ = 360^\circ$$

(c)

To find the diagonals, we use the formula.
 $n(n-3)/2$, where n is the number of sides.

Thus

- (i) Hexagon has 9 diagonals
- (ii) Pentagon has 5 diagonals.
- (iii) Heptagon has 14 diagonals.
- (iv) Octagon has 20 diagonals
- (v) Triangle has 0 diagonals.
- (vi) Nonagon has 27 diagonals.
- (vii) Quadrilateral has 2 diagonals.



MENTAL MATHS

Write T for true and F for false statements :

1. A diagonal of a polygon is a line segment connecting its two non-consecutive vertices. _____
2. A rhombus is a regular quadrilateral. _____
3. Sum of the interior angles of an 8-sided polygon is 1080° . _____
4. For a regular polygon, number of sides = $\frac{360^\circ}{\text{Each exterior angle}}$. _____
5. The maximum exterior angle possible for a regular polygon is 100° . _____
6. The diagonals of a rectangle are equal and bisect each other. _____
7. Every square is a rhombus. _____
8. Every parallelogram is a rhombus. _____
9. The sum of the measures of interior angles of a polygon of n -sides is 360° . _____
10. Every parallelogram is a trapezium. _____

Solution:

① T

② F

Because a non-square rhombus is not a equiangular, so it is not a regular quadrilateral.

③ T

④ T

⑤ F

Each exterior angle of an equilateral triangle is 120° and hence this is the maximum possible value of exterior angle of a regular polygon.

⑥ T

⑦ T

⑧ F

Every parallelogram is not a rhombus. To be a rhombus, the four sides have to be equal and the opposite sides have to be parallel.

⑨ F

The sum of the measures of interior angles of a polygon of n -sides is $(2n-4) \times$ right angles.

⑩ F

All trapeziums are parallelogram but all parallelograms can't be trapezoid.