

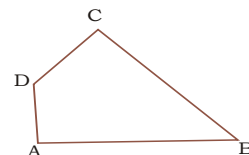
**QUADRILATERAL**

§§ **Quadrilateral:** A quadrilateral is a closed figure formed by four line segments such that no two line segments cross each other except at their end points.

Quadrilaterals are classified into two types.

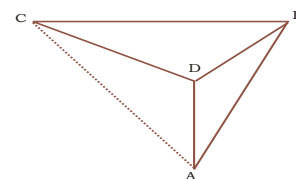
**i) Convex quadrilateral:**

A quadrilateral in which the measure of each interior angle is less than  $180^\circ$  is called a convex quadrilateral.



**ii) Concave quadrilateral:**

A quadrilateral in which the measure of one of the interior angles is more than  $180^\circ$  is known as a concave quadrilateral.



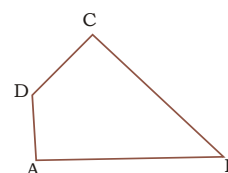
§§ **In a quadrilateral ABCD:**

1. Four sides  $\overline{AB}, \overline{BC}, \overline{DA}, \overline{CD}$  .
2. Four angles  $\angle A, \angle B, \angle C, \angle D$
3. Four vertices A,B,C,D.
4. Two diagonals  $\overline{AC}, \overline{BD}$

(Diagonal : It is a line segment joining the opposite vertices of quadrilateral)

§§ **In a quadrilateral ABCD:**

1. Adjacent sides:  $\overline{AB}$  and  $\overline{BC}$  ;  $\overline{BC}$  and  $\overline{CD}$  ;  $\overline{CD}$  and  $\overline{DA}$
2. Adjacent angles:  $\angle A$  and  $\angle B$ ;  $\angle B$  and  $\angle C$ ;  $\angle C$  and  $\angle D$ ;  $\angle D$  and  $\angle A$
3. Opposite sides:  $\overline{AB}$  and  $\overline{CD}$  ;  $\overline{AD}$  and  $\overline{BC}$
4. Opposite angles:  $\angle A$  and  $\angle C$ ;  $\angle B$  and  $\angle D$



**Note:**

1. The sum of the interior angles in a quadrilateral is  $360^\circ$  . (i.e., 4 right angles)

**Example:** In a quadrilateral ABCD,  $\angle A + \angle B + \angle C + \angle D = 360^\circ$

2. Each diagonal divides the quadrilateral into two triangles.

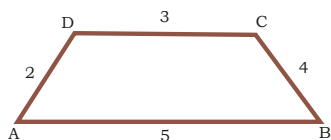
Example: The diagonal AC divides the quadrilateral ABCD into  $\triangle ABC$  and  $\triangle ADC$  .

3. In general, convex quadrilateral is treated as quadrilateral
4. In a convex quadrilateral, both diagonals lie in the interior where as in the case of concave quadrilateral one diagonal lies in the interior and the other lies in the exterior.

**Ψ Perimeter:**

Perimeter of a quadrilateral is the sum of the lengths of all sides of the quadrilateral.

**Example:** The perimeter of the following quadrilateral =  $AB + BC + CD + DA = 5 + 4 + 3 + 2 = 14$  units.



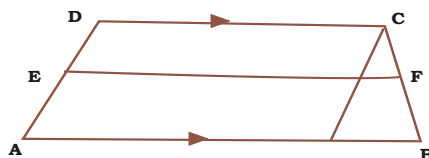
1. Interior point of the quadrilateral: A point is said to be an interior point of the quadrilateral if it lies inside the quadrilateral.
2. Exterior point of the quadrilateral: A point is said to be an exterior point of the quadrilateral if it lies outside the quadrilateral.
3. Point on the quadrilateral: A point is said to be on the quadrilateral if it lies on any side of quadrilateral.

**§§ Trapezium:** A Trapezium is a quadrilateral in which one pair of opposite sides are parallel.

**Note:** The parallel sides ( $\overline{AB}, \overline{CD}$ ) are called the bases of the trapezium. And the other two sides are called its non-parallel sides (legs). ( $\overline{BC}, \overline{AD}$ )



**Ψ Median of Trapezium:** A line segment formed by joining the midpoints of non parallel sides of a trapezium is called the median of a trapezium.



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

1. The median of a trapezium is parallel to the bases of the trapezium.

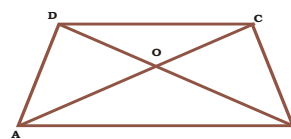
**Ψ Altitude of a Trapezium:** The perpendicular distance from vertex to the opposite base.

**¶¶ Properties:**

i) Consider a trapezium ABCD in which  $\overline{AB} \parallel \overline{CD}$ .

$$\angle A + \angle D = 180^\circ, \angle B + \angle C = 180^\circ$$

ii) The diagonals of a trapezium divides each other proportionally.



iii) If the diagonals are proportional in a quadrilateral then it forms a trapezium.

**Note:** Difference between trapezoid and trapezium

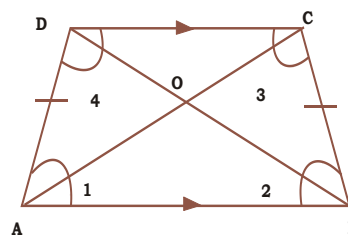
§§ **Trapezoid:** A quadrilateral with no sides parallel

Ψ **Trapezium :** A quadrilateral with one pair of parallel sides

Ψ **Isosceles Trapezium:** A trapezium in which the non parallel sides are equal to each other is known as an Isosceles trapezium. In the Isosceles trapezium ABCD,  $\overline{AB} \parallel \overline{CD}$ ,  $AD = BC$

¶¶ **Properties:**

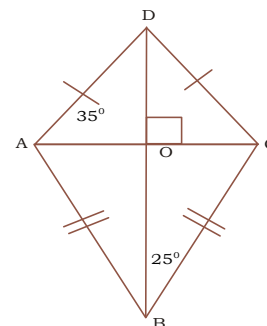
1.  $\angle 1 + \angle 4 = 180^\circ$  and  $\angle 2 + \angle 3 = 180^\circ$
2. Base angles are equal ( $\angle 1 = \angle 2$  and  $\angle 3 = \angle 4$ )
3. The lengths of diagonals are equal ( $AC = BD$ )



§§ **Kite:** A quadrilateral having two pairs of equal adjacent sides but unequal opposite sides is called a kite. A kite ABCD with  $AB = BC$  &  $AD = CD$

¶¶ **Properties:**

1. The diagonals of kite are perpendicular to each other i.e.,  $\overline{BD} \perp \overline{AC}$ .
2.  $OA = OC$
3.  $\angle A = \angle C$
4. Diagonal BD bisects  $\angle B, \angle D$
5. Diagonal BD divides the kite into two congruent triangles.

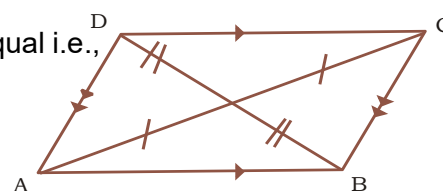


§§ **Parallelogram:**

A quadrilateral in which both pairs of opposite sides are parallel is called a parallelogram.

¶¶ **Properties:**

1. In a parallelogram ABCD two pairs of opposite sides are equal i.e.,  $AB = CD$ ; and  $BC = AD$ .
2. Opposite angles are equal i.e.,  $\angle A = \angle C$ ;  $\angle B = \angle D$ .
3. The diagonals of a parallelogram bisect each other ( $AO = OC$ ,  $BO = OD$ ).
4. In a parallelogram each diagonal divides it into two congruent triangles.
5. In a parallelogram the sum of the adjacent angles is equal to  $180^\circ$ .



i.e., They are supplementary.  $\angle A + \angle B = 180^\circ$ ;  $\angle A + \angle D = 180^\circ$ ;  $\angle C + \angle D = 180^\circ$ ;  $\angle B + \angle C = 180^\circ$

6. If a quadrilateral has two pairs of opposite sides are parallel and equal then it forms a parallelogram.

§§ **Rectangle:**

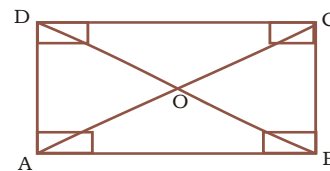
If one of the angles of a parallelogram is a right angle, then all angles are right angles. Such a parallelogram is called a rectangle. (OR)

A parallelogram in which one angle is a right angle is called a rectangle.

¶¶ **Properties:**

**A rectangle satisfies all the properties of parallelogram.**

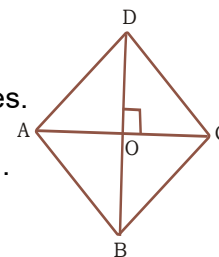
- a) The length of the diagonals of a rectangle are equal.
- b) Opposite sides are equal.
- c) Opposite angles are equal.
- d) Each diagonal divides it into congruent right angled triangles
- e) The diagonals of a rectangle bisect each other.



§§ **Rhombus:** A parallelogram in which two adjacent sides are equal is called a rhombus.

¶¶ **Properties:**

- a) Each diagonal of a rhombus divides it into two congruent isosceles triangles.
- b) Opposite angles are equal and the sum of any two adjacent angles is  $180^\circ$ .
- c) The diagonals bisect each other perpendicularly.
- d) The diagonals AC bisects  $\angle A$  and  $\angle C$ ; the diagonal BD bisects  $\angle B$  and  $\angle D$ .



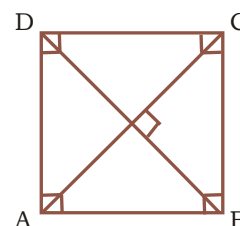
§§ **Square:**

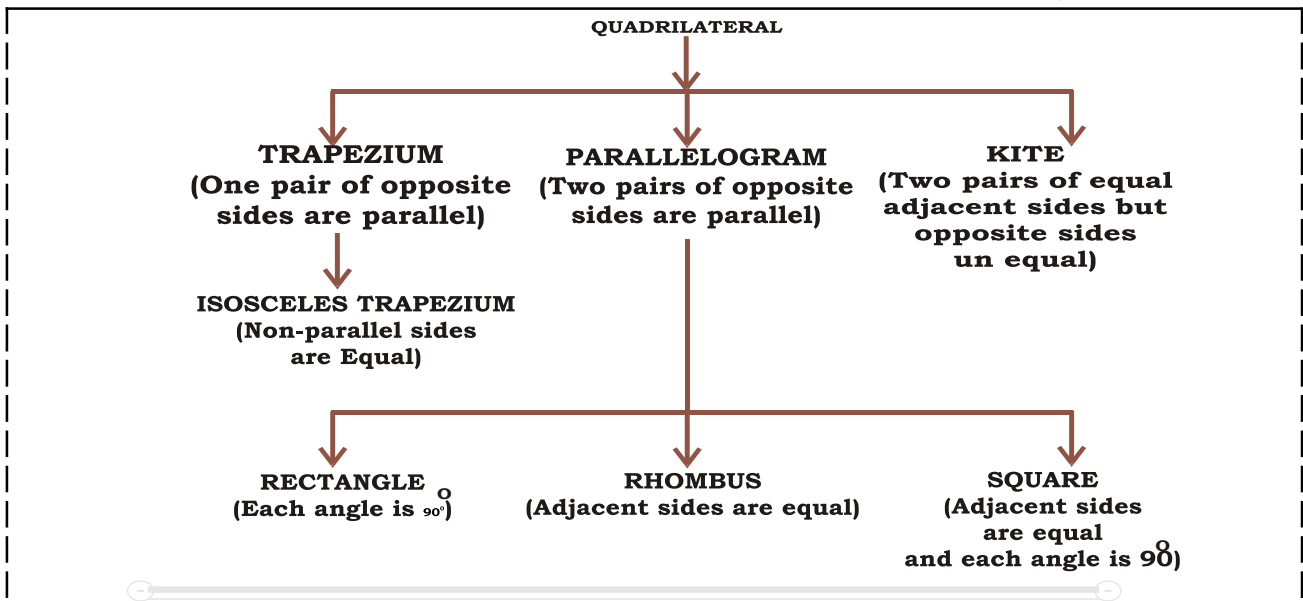
A rectangle in which adjacent sides are equal is called a square. (OR)

A rhombus in which one of its angles is a right angle is called a square.

¶¶ **Properties:**

- a) All sides are equal.
- b) Each angle is equal to  $90^\circ$
- c) The diagonals are equal and are mutually perpendicular bisectors.
- d) Each diagonal divides the square into two congruent right angled isosceles triangles.
- e) The quadrilateral formed by joining successively the midpoints of sides of a square is a square.





**EXAMPLE**

✓ **EX 1:** The angles of a quadrilateral are in the ratio 5:6:10:15. Find the angles of the quadrilateral.

**Solution :** Let the angles of the quadrilateral be 5x, 6x, 10x, and 15x.

The sum of the angles of a quadrilaterals is  $360^\circ$

Thus,

$$5x + 6x + 10x + 15x = 360^\circ$$

$$\Rightarrow 36x = 360^\circ \Rightarrow x = 10$$

Thus, the angles of the quadrilateral are  $5 \times 10 = 50^\circ$ ;

$6 \times 10 = 60^\circ$  ;  $10 \times 10 = 100^\circ$  and  $15 \times 10 = 150^\circ$ .

✓ **Ex 2:** The sum of two opposite angles of a quadrilateral is  $220^\circ$ . The other two angles of the quadrilateral are equal. Find the equal anlges.

**Solution:** let the opposite equal angles be x. Since the sum of all the angles of a quadrilateral is  $360^\circ$ .

Thus,

$$x + x + 220^\circ = 360^\circ$$

$$\Rightarrow 2x + 220 = 360^\circ$$

$$\Rightarrow 2x = 140 \Rightarrow x = 70^\circ$$

Thus, the two equal and opposite angles are  $70^\circ$

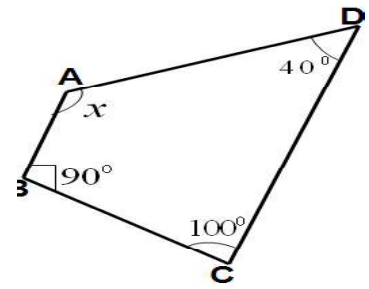
✓ **Ex 3:** Find the value of x in the quadrilateral.

**Solution:** The sum of the interior angles

of a quadrilateral is  $360^\circ$

Thus,  $x + 90^\circ + 100^\circ + 40^\circ = 360^\circ$

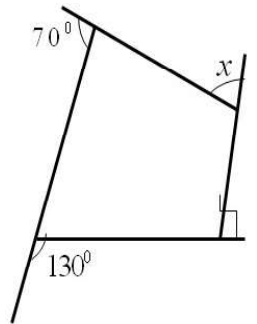
$\Rightarrow x = 360^\circ - (90 + 100 + 40) \Rightarrow x = 130^\circ$



✓ **Ex 4 :** Find the measure of x in the given figure.

**Solution :**  $x + 70^\circ + 130^\circ + 90^\circ = 360^\circ$

or  $x = 360^\circ - 290^\circ = 70^\circ$



✓ **Ex 5 :** Find the number of sides of a regular polygon whose all exterior angles measure  $60^\circ$ .

**Solution :** Sum of the exterior angles =  $360^\circ$

Measure of each exterior angle =  $60^\circ$

Then, number of exterior angles =  $\frac{360}{60} = 6$

We know that an n - side polygon has n exterior angles.

Thus, the polygon has 6 sides.

✓ **Ex : 6-** Two adjacent angles of a parallelogram are in the ratio 1:3 find the measure of each of its angles

**Solution :** Two adjacent angles of a parallelogram are = x, 3x

Sum of adjacent angles of a parallelogram = 180

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

$x = 45 \Rightarrow \angle A = x = 45 \Rightarrow \angle A = \angle C = 45^\circ$

$\angle B = \angle D = 135^\circ$  (opposite angles are equal in the parallelogram)

✓ **EX 7 :** Three angles of a quadrilateral are equal and the fourth angle measures  $120^\circ$ . What is the measure of each of the equal angles.

**Solution :** Three angles of a quadrilateral are equal

each angle = x

Fourth angle =  $120^\circ$

Sum of the angles quadrilateral = 360

$$x + x + x + 120 = 360$$

$$3x + 120 = 360$$

$$3x = 360 - 120$$

$$3x = 240 \quad x = 80$$

Angle in a quadrilateral are 80, 80, 80, 120

√ **Ex : 7** If one angle in a parallelogram is 100 then find other 3 angles In a parallelogram ABCD

$\angle A = 100$  then

$\angle A = \angle C$  and  $\angle B = \angle D$  (opposite angles are equal in parallelogram)

$\angle A + \angle B = 180$  (sum of adjacent angles is  $180^\circ$ )

So that  $\angle A = 100$   $\angle C = 100$

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

$$100 + \angle B = 180$$

$$\angle B = 80 \quad \text{and} \quad \angle D = 80$$

$$\therefore \angle A = 100, \angle B = 80, \angle C = 100, \angle D = 80$$

**TEACHING TASK**

**I. MCQ's with single correct answers**

1. Quadrilaterals are classified into  
 A) two types                      B) three types                      C) four types                      D) five types
2. In a quadrilateral, three angles are  $90^\circ, 65^\circ, 55^\circ$  then the fourth angle is.....  
 A)  $140^\circ$                       B)  $135^\circ$                       C)  $120^\circ$                       D)  $150^\circ$
3. In a quadrilateral ABCD,  $\angle A = 60^\circ, \angle B = 120^\circ$ , then  $\angle C + \angle D =$  \_\_\_\_\_  
 A)  $140^\circ$                       B)  $180^\circ$                       C)  $120^\circ$                       D)  $150^\circ$
4. Each diagonal divides the quadrilateral into \_\_\_\_\_ triangles  
 A) 2                      B) 3                      C) 4                      D) 5
5. In a trapezium ABCD in which  $\overline{AB} \parallel \overline{CD}$  then  
 A)  $\angle A + \angle D =$  Straight line angle,  $\angle B + \angle C =$  right angle  
 B)  $\angle A + \angle D =$  Right angle,  $\angle B + \angle C =$  Straight line angle





- A)  $\frac{1}{2} \times 60 \times 45$       B) 1250      C) 1350      D) 1530

15. In a parallelogram ABCD, which of the following is/are true?

- A)  $\angle A + \angle B = 180^\circ$       B)  $\angle A + \angle D = 180^\circ$   
 C)  $\angle C + \angle D = 180^\circ$       D)  $\angle B + \angle C = 180^\circ$

**Assertion and Reasoning type questions:**

◆ This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.

- A) Both A and R are correct  
 B) Both A and R are False  
 C) A is correct and R is incorrect      D) A is incorrect and R is correct

16. **A** : A parallelogram in which two adjacent sides are equal is called a rhombus.

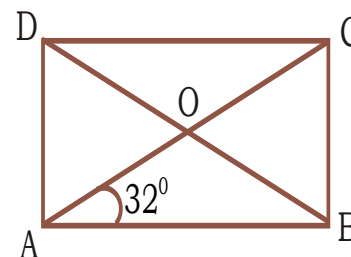
**R** : A closed figure bounded by four lines segments is called a quadrilateral.

**Comprehension**

◆ This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. Choose the correct option.

In the given figure ABCD is a rectangle

whose diagonals AC and BD intersect at 'O' if  $\angle OAB = 32^\circ$



17. The value of  $\angle ACB =$   
 A)  $58^\circ$       B)  $90^\circ$       C)  $60^\circ$       D)  $30^\circ$
18. The value of  $\angle OBC =$   
 A)  $90^\circ$       B)  $60^\circ$       C)  $58^\circ$       D)  $45^\circ$
19. From the adjoining figure  $BC^2 =$  \_\_\_\_\_  
 A)  $AB^2 - AC^2$       B)  $AC^2 - AB^2$       C)  $2AC^2$       D)  $2AB^2$

**Matrix match type :**

◆ This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column-I** have to be matched with statements (p, q, r, s) in **Column-II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.

If the correct matches are A-p, A-s, B-r, B-r, C-p, C-q and D-s, then the correct bubbled 4\*4 matrix should be as follows:

- | 20. Column - I   | Column -II |
|--|------------|
| a) A Closed figure bounded by four line segments is called | p) Rhombus |
| b) A rhombus in which one of its angles                    | q) Square  |

is a right angled is called a

- c) A parallelogram in which two adjacent sides are equal is called as
- d) The diagonals of a rectangle are
- r) Quadrilateral
- s) Equal
- t) Rectangle

21.

**Column I**

- 1) Quadrilateral in which one pair of opposite sides are equal.
- 2) A quadrilateral having two pairs of equal adjacent sides but unequal opposite sides are called
- 3) One pair of opposite sides are parallel
- 4) In which quadrilateral diagonals divides into two congruent triangles.

**Column II**

- a) Isosceles trapezium
- b) Kite
- c) Parallelogram
- d) Trapezium
- e) Rhombus

**LEARNER'S TASK**

**BEGINNERS**

**I. MCQ's with single correct answers**

- 1. Each diagonal divides the parallelogram into two \_\_\_\_\_ triangles.  
A) 2                      B) 3                      C) 4                      D) 5
- 2. In a parallelogram ABCD,  $\angle A - \angle C =$  \_\_\_\_\_  
A)  $0^\circ$                       B)  $90^\circ$                       C)  $180^\circ$                       D)  $360^\circ$
- 3. Each diagonal of a Rhombus divides into two  
A) right-angled triangles                      B) congruent isosceles triangles  
C) non-congruent isosceles triangles                      D) Scalene triangle
- 4. In a Rhombus opposite angles are \_\_\_\_\_  
A) equal                      B) unequal                      C)  $90^\circ$                       D) acute
- 5. In a Rhombus ABCD the diagonal AC bisects  $\angle A, \angle C$  and the diagonal BD bisects  
A)  $\angle A, \angle B$                       B)  $\angle C, \angle D$                       C)  $\angle B, \angle D$                       D)  $\angle C, \angle A$
- 6. Each side of a rhombus is 10cm long and one of its diagonals measures 16cm then the length of the other diagonal is \_\_\_\_\_  
A) 3 cm                      B) 6 cm                      C) 8 cm                      D) 12 cm
- 7. The sum of all the angles of a quadrilateral is \_\_\_\_\_  
A)  $0^\circ$                       B)  $90^\circ$                       C)  $180^\circ$                       D)  $360^\circ$

**EXPLORERS**

**MCQ's with more than one correct answers**

◆ This section contains multiple choice questions. Each question has 4 choices (A), (B), (C), (D), out of which ONE or MORE is correct. Choose the correct options

1. A quadrilateral has  
 A) four sides                      B) four angles                      C) four vertices                      D) two diagonals
2. The sum of the interior angles in a quadrilateral is  
 A)  $180^\circ$                       B)  $360^\circ$                       C) 4 right angles                      D) Two right angles
3. Which of the following statements is/are true?  
 A) In a trapezium the diagonals bisect each other  
 B) In the isosceles trapezium the lengths of diagonals are equal  
 C) In a kite the diagonals are perpendicular to each other  
 D) None of these
4. A quadrilateral in which both pairs of opposite sides are parallel is called  
 A) Rectangle                      B) parallelogram                      C) Square                      D) rhombus

**Assertion and Reasoning type questions:**

◆ This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.

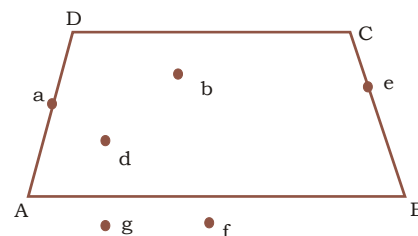
- A) Both A and R are correct
- B) Both A and R are False
- C) A is correct and R is incorrect                      D) A is incorrect and R is correct

5. **Assertion :** A quadrilateral is a simple closed figure  
**Reasoning :** Quadrilaterals are formed by 4 line segments such that no two line segments cross each other

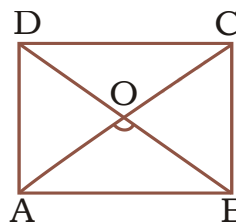
**Comprehension :**

◆ This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. Choose the correct option.

- A) A point is said to be an interior point of the quadrilateral if it lies inside the quadrilateral. If it lies outside, it is exterior. If it lies on any side it is said to be on the quadrilateral from the given figure



6. Interior points of the quadrilateral ABCD  
 A) a,b                      B) c,d                      C) b,d                      D) e,f
  7. The points a and e are  
 A) Interior                      B) Exterior                      C) On the quadrilateral                      D) do not exist
  8. Exterior points of ABCD are  
 A) g,f                      B) a,d                      C) d,e                      D) b,e
- B) The lengths of the diagonals of a rhombus are  $AC=24$  cm and  $BD=18$  cm respectively
  9. Area of the rhombus is  
 A)  $216 \text{ cm}^2$                       B)  $316 \text{ cm}^2$                       C)  $416 \text{ cm}^2$                       D)  $250 \text{ cm}^2$
  10. In the above figure ABCD,  $AO = OC =$   
 A) 24                      B) 12                      C) 18                      D) 9
  11. In the above figure ABCD,  $BO = OD =$   
 A) 18                      B) 9                      C) 12                      D) 24



**Match the following:**

◆ This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column-I** have to be matched with statements (p, q, r, s) in **Column-II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct matches are A-p, A-s, B-r, B-r, C-p, C-q and D-s, then the correct bubbled 4\*4 matrix should be as follows:

- |  |   |
|--|---|
| <p><b>12.</b></p> <p><b>Column - I</b></p> <p>a) A parallelogram having all sides are equal is called</p> <p>b) A quadrilateral in which two opposite sides are parallel is called</p> <p>c) A quadrilateral in which two pair of adjacent sides are equal is called</p> <p>d) A parallelogram each of whose angles measures <math>90^\circ</math> is called</p> | <p><b>Column -II</b></p> <p>p) Kite</p> <p>q) Trapezium</p> <p>r) Rhombus</p> <p>s) Rectangle</p> <p>t) Parallelogram</p> |
|--|---|

- |  |  |
|--|--|
| <p><b>13.</b></p> <p><b>Column - I</b></p> <p>1) In ABCD, <math>\angle A + \angle C = 180^\circ</math>; <math>\angle B + \angle D =</math></p> <p>2) Sum of interior angles in a quadrilateral</p> <p>3) Interior angle <math>&lt; 180^\circ</math></p> <p>4) Interior angle <math>&gt; 180^\circ</math></p> | <p><b>Column - II</b></p> <p>a) Concave quadrilateral</p> <p>b) <math>180^\circ</math></p> <p>c) <math>360^\circ</math></p> <p>d) Convex quadrilateral</p> <p>e) <math>90^\circ</math></p> |
|--|--|



**☐☐ TEACHING TASK :**

- |       |       |                        |           |         |                           |       |       |      |
|-------|-------|------------------------|-----------|---------|---------------------------|-------|-------|------|
| 1-A,  | 2-D,  | 3-B,                   | 4-A,      | 5-C,    | 6-D,                      | 7-B,  | 8-B,  | 9-B, |
| 10-C, | 11-C, | 12-A,B,D;              | 13-A,C,D; | 14-A,C; | 15-A,B,CD;                | 16-B, | 17-A, |      |
| 18-C, | 19-B, | 20-a-r, b-q, c-p, d-s; |           |         | 21-i-d, ii-b, iii-a, iv-e |       |       |      |

**☐☐ LEARNER'S TASK :**

- |                                 |        |       |           |       |                        |                          |
|---------------------------------|--------|-------|-----------|-------|------------------------|--------------------------|
| ☐ <b>BEGINNERS :</b> 1-A,2-A,   | 3-B,   | 4-A,  | 5-C,      | 6-D,  | 7-D,                   |                          |
| ☐ <b>EXPLORERS :</b> 1-A,B,C,D; | 2-B,C; | 3-B,C | 4.A,B,C,D | 5-A,  | 6-C,                   | 7-C,                     |
|                                 | 8-A,   | 9-A,  | 10-B,     | 11-B, | 12-a-r, b-t, c-p, d-s; | 13-i-b, ii-c,iii-d, iv-a |