ATOMIC ENERGY EDUCATION SOCIETY

DISTANCE EDUCATION PROGRAMME

CLASS 8- MATHEMATICS

# CHAPTER-3

# UNDERSTANDING QUADRILATERALS

MODULE-1/4

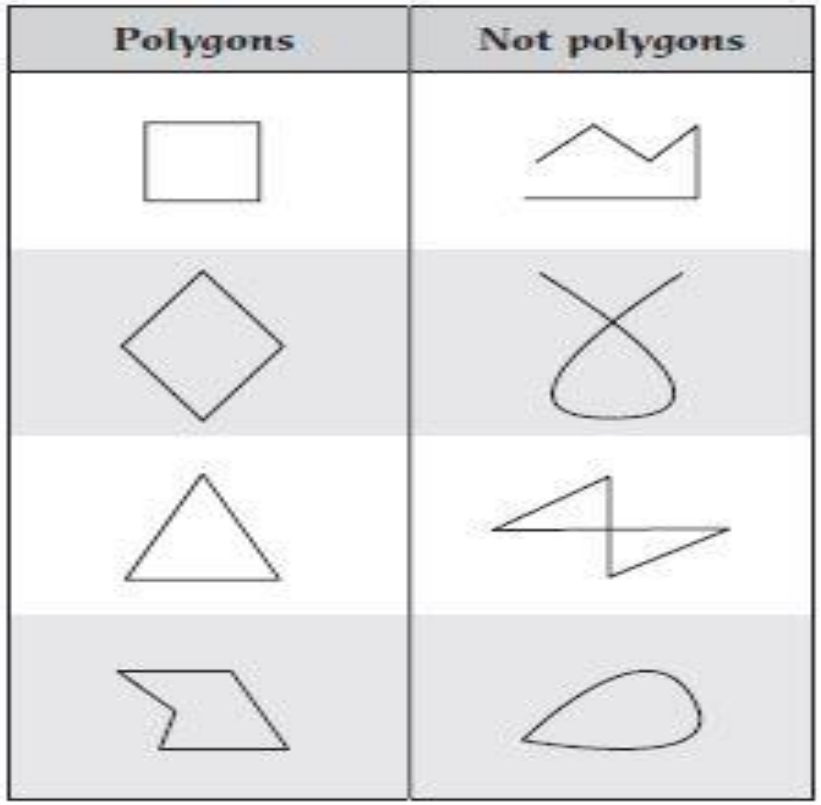
# Module-1

1) Polygon - Definition
2) Classification of polygons
3) Diagonal of a polygon
3)Convex & concave polygons
4)Regular and Irregular polygons
5)Angle sum property of a quadrilateral
6) Angle sum property of a polygon
7) Problems.

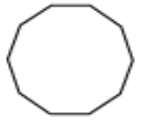
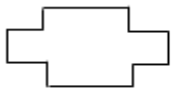
# 3. Understanding quadrilaterals

Let us learn some terms like polygon, convex &concave polygon, regular & irregular polygon.

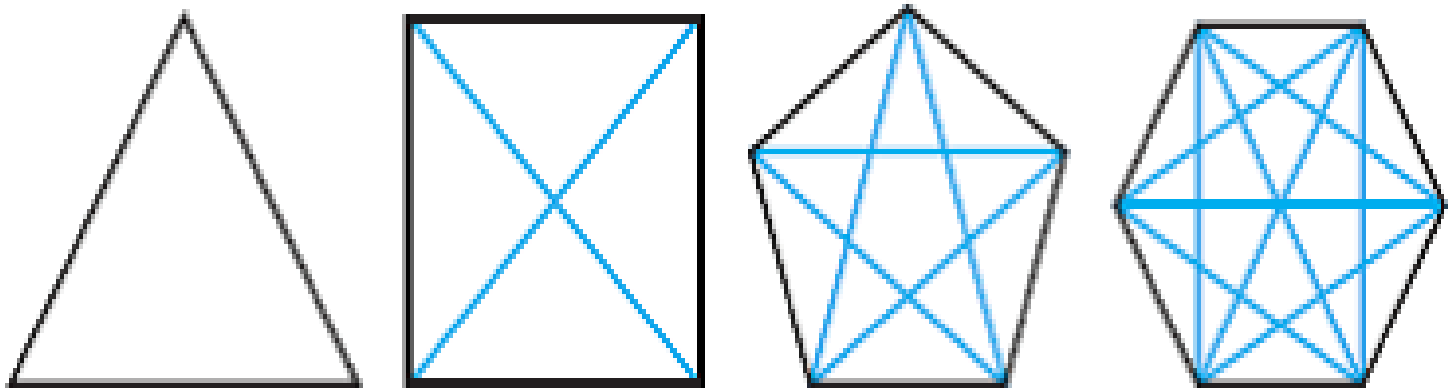
1)Polygon- A simple closed figure made up of only line segments is called a polygon.



2) For a figure to be a polygon we need minimum 3 line segments. Polygons are classified according to the number of sides. Classification of polygons is as follows.

| Name | Number of sides | Example |
|---|---|---|
| ***Tri***angle | 3 |  |
| ***Quad***rilateral | 4 |  |
| ***Penta***gon | 5 |  |
| ***Hexa***gon | 6 |  |
| ***Hepta***gon | 7 |  |
| ***Octa***gon | 8 |  |
| ***Nona***gon | 9 |  |
| ***Deca***gon | 10 |  |
| ***Dodeca***gon | 12 |  |
| *n* -gon | n | |

3) Diagonal of a polygon- A line segment joining two non-consecutive vertices is called as a diagonal. Let us see how many diagonals are there in the following polynomials.



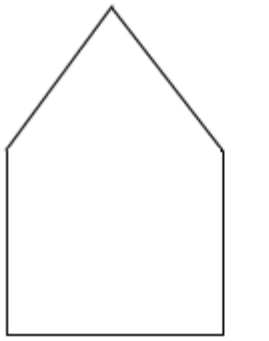
| Triangle | Quadrilateral | Pentagon | Hexagon |
|---|---|---|---|
| 3 sides | 4 sides | 5 sides | 6 sides |
| 0 diagonals | 2 diagonals | 5 diagonals | 9 diagonals |

Can you generalise this for a polynomial having ‘n’ sides?

No. of diagonals of a polygon $= \frac{n(n-3)}{2}$ , n$>$ 3 of ‘n’ sides

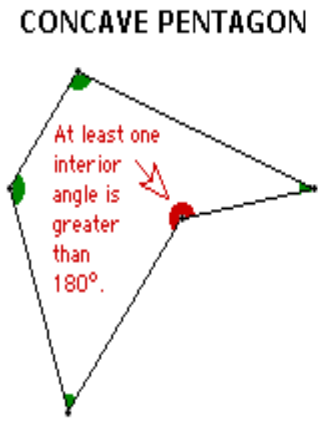
Note – There is only one polygon which has number of sides and number of diagonals same and it is pentagon.

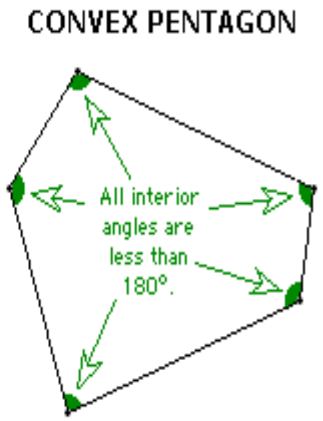
4) **Convex and Concave polygon** – A polygon is said to be a convex polygon if the line segment joining any two points in its interior lies completely in its interior. A polygon which is not convex Is called as concave polygon.



CONVEX POLYGON

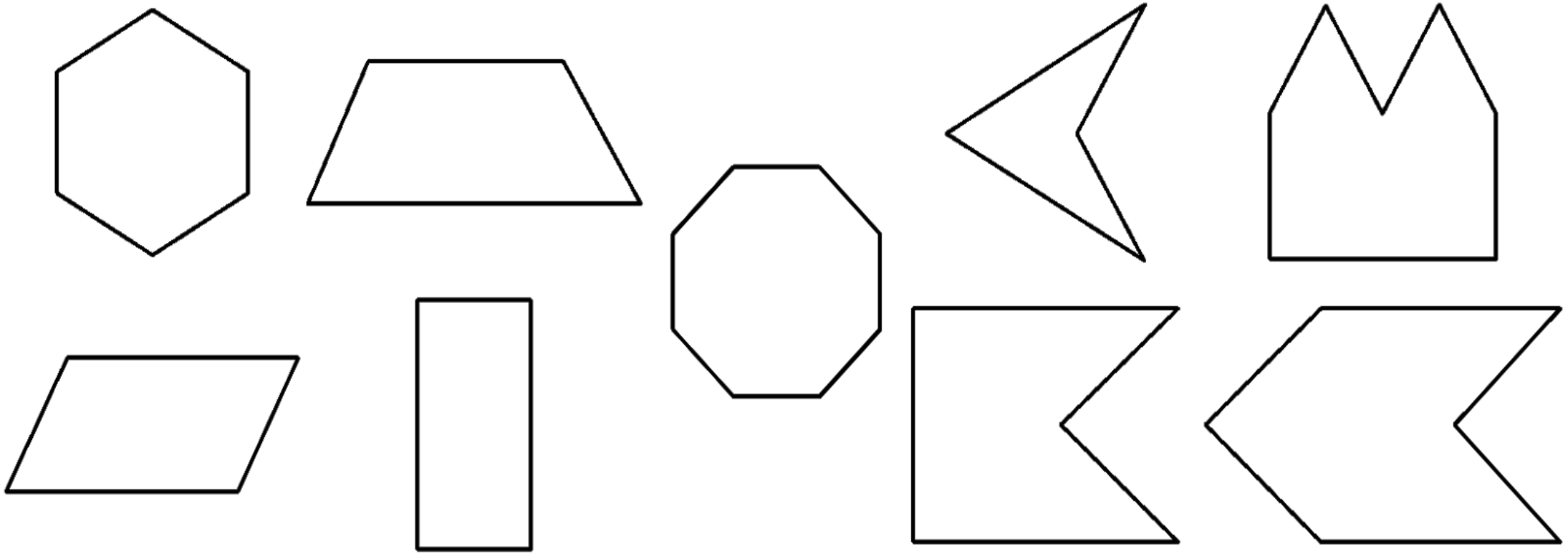
CONCAVE POLYGON



You can see that in a convex polygon each of the interior angles is less than 180° where as in a concave polygon you can see that one of the interior angles is greater than 180°.Also in a convex polygon no portion of the diagonal is in its exterior. In a concave polygon one of the diagonal except its end points lies in the exterior of the polygon.

Let us see some more convex and concave polygons.



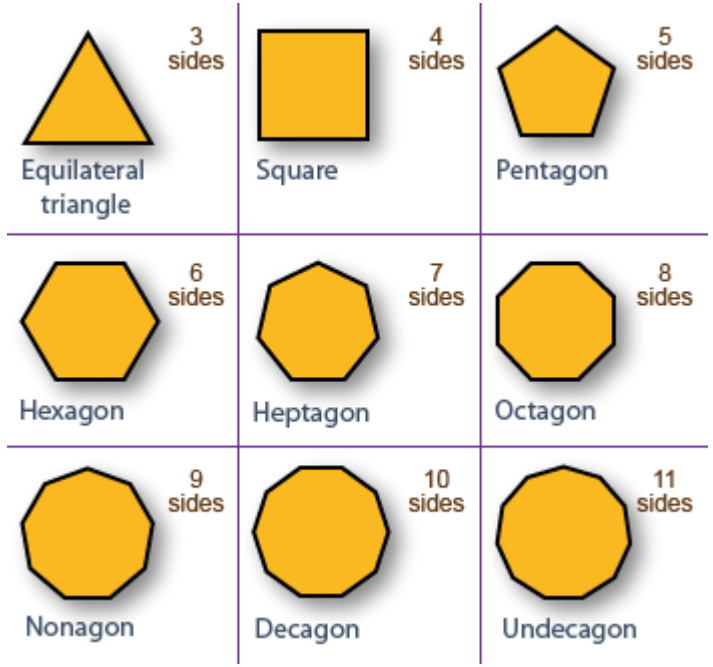
Convex polygons

Concave polygons

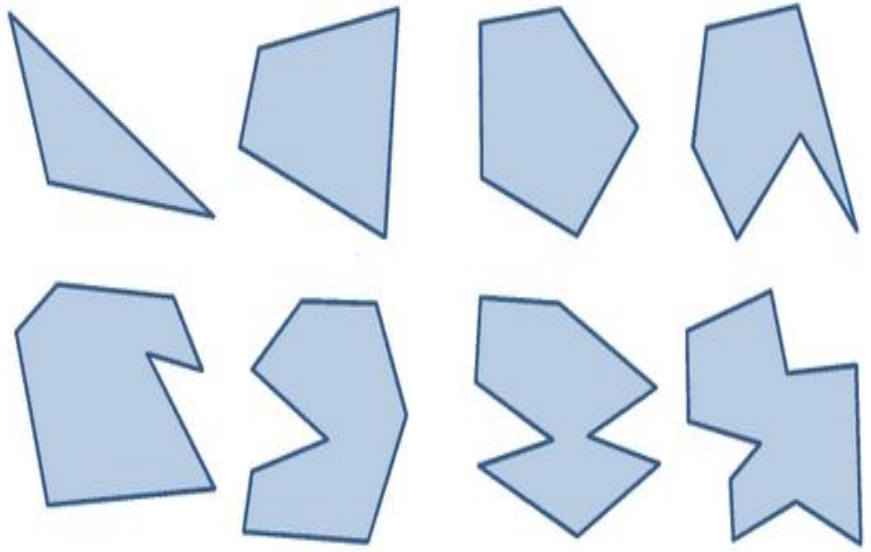
**6) Regular and Irregular polygons** – A polygon is said to be a regular polygon if all its sides and all its angles are equal.

Let us see some examples of regular and irregular polygons.

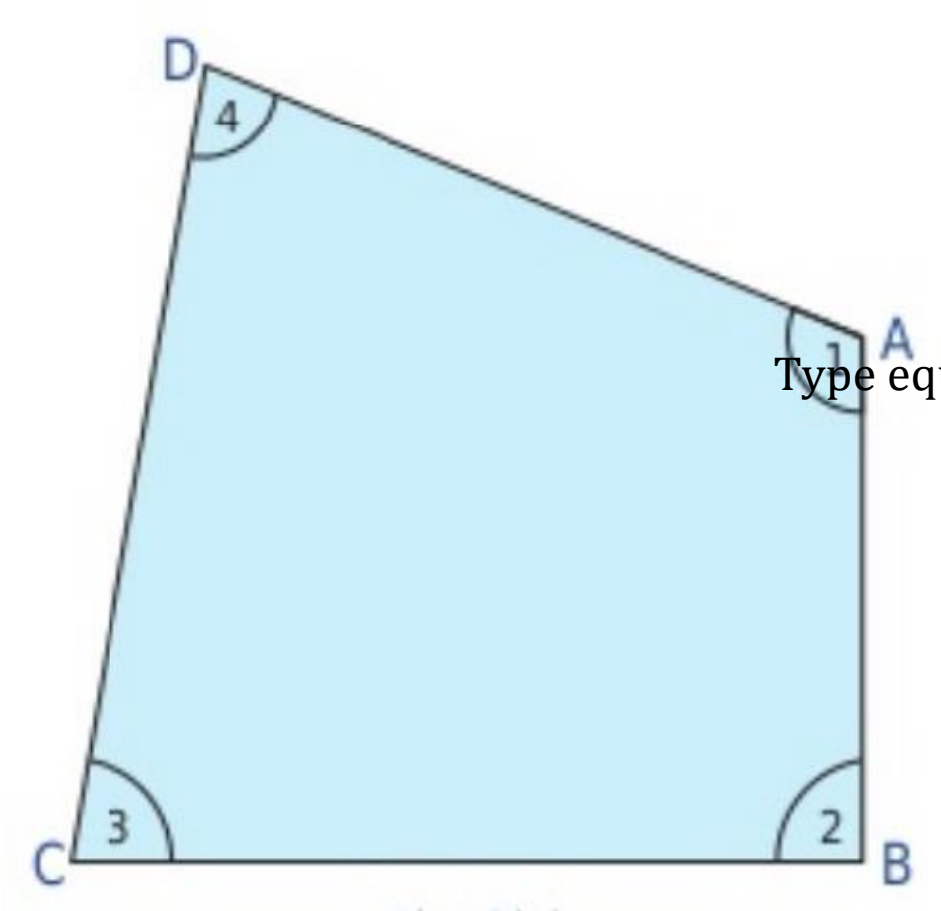
## Regular polygons



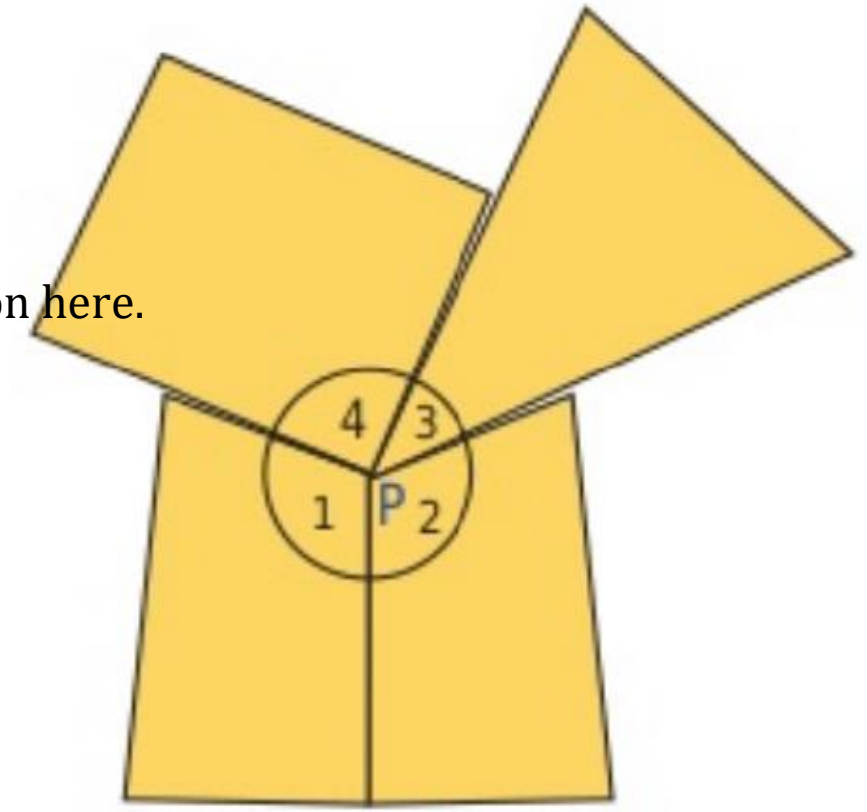

## Irregular polygons



**7) Angle sum property of a polygon** – We know that sum of the angles of a triangle is 180°.Let us find the sum of the angles of a  quadrilateral.




Type equation here.



This is an activity in which all the four angles of the quadrilateral ABCD are cut and joined together forming a circle.

This implies that sum of the four angles of a quadrilateral is 360° or 2 straight angles or 4 right angles.

i. e. $\angle A + \angle B + \angle C + \angle D = 360°$

Let us prove that sum of the angles of a quadrilateral is360°

In $\Delta ABC$ , $\angle 4 + \angle 5 + \angle 6 = 180°$ -----(1)

In $\Delta ACD$ , $\angle 1 + \angle 2 + \angle 3 = 180°$ -----(2)

Adding equations (1) and (2), we get,

$\angle 4 + \angle 5 + \angle 6 + \angle 1 + \angle 2 + \angle 3 = 180 + 180°$

Or, $(\angle 1 + \angle 4) + \angle 6 + (\angle 2 + \angle 5) + \angle 3 = 360°$

Or, $\angle A + \angle B + \angle C + \angle D = 360°$

Hence ,

sum of the angles of a quadrilateral is 360°

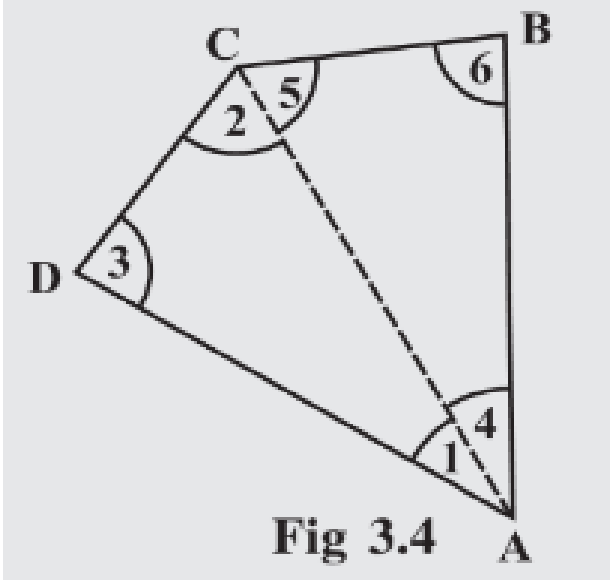
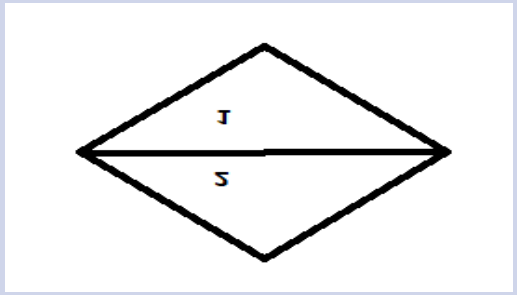
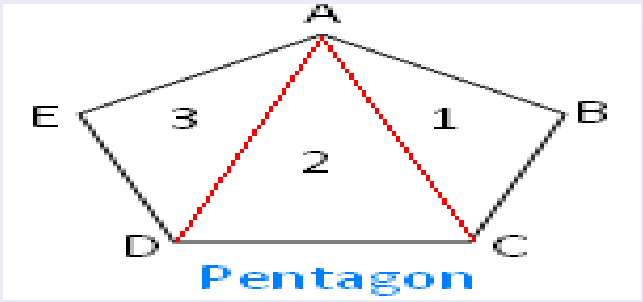
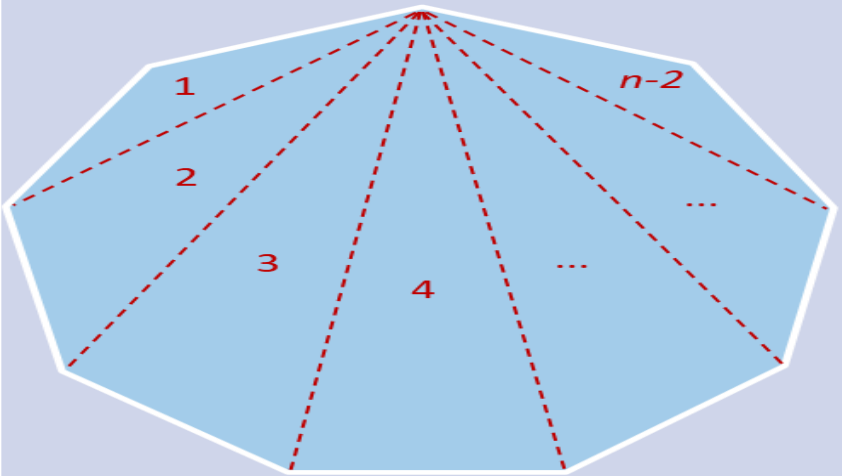


Fig 3.4

| Figure | No. of sides | No. of triangles | Angle sum |
|---|---|---|---|
|  | 4 | 2 | 2 x 180°<br>= 360° |
|  | 5 | 3 | 3 x 180°<br>= 540° |
|  | n | n-2 | (n -2) x 180° |

You have seen that in a quadrilateral the no. of triangles formed is 2.In a pentagon the no. of triangles formed is 3.So you can observe that in a polygon the number of triangles is two less than that of the number of sides.

In a quadrilateral , no. of triangle =2

Therefore, angle sum of a quadrilateral = 2 x180°=360°

In a pentagon, no. of triangles =3

Hence , angle sum of a pentagon= 3 x 180°= 540°

In general, angle sum of a polygon of ‘n’ sides= (n-2) x 180°

In a regular polygon we know that all the angles are equal.
Hence , if we want to find out the measure of each angle of a regular polygon, then,

$$m(\text{interior angle of a regular polygon}) = \frac{(n-2)x\ 180^\circ}{n}$$

## Practice Problems

Q.1.Find the sum of angles of a convex polygon of 8 sides.

Soln. We know, angle sum of a polygon of 'n' sides = (n-2) x 180°

Number of sides = 8 ,i.e. It is an octagon.

∴ sum of angles of an octagon = ( 8 -2) x 180°

=6 x 180°

= 1080°

Q.2. The angles of a quadrilateral are 120°, 130°, 50°.Find the fourth angle.

Soln. Let the measure of the fourth angle be = x°

We know that sum of the angles of a quadrilateral is = 360°
So, 120° +130° + 50° + x° = 360°
i.e. 300° + x° = 360°, Thus, x° = 360° - 300° = 60°

Q.3 Find the measure of each of the interior angle of a regular pentagon.

Soln. In a regular polygon, we know that,

$$\text{measure of interior angle} = \frac{(n-2)x\ 180^\circ}{n}$$

$$= \frac{(5-2)x\ 180^\circ}{5}$$

$$= \frac{3\ x\ 180^\circ}{5}$$

$$= \frac{540^\circ}{5}$$

Measure of each int. angle of

a regular pentagon = 108°

Q.4. Find the angles of a quadrilateral if its angles are in the ratio 1:2;3:4

Soln. Let the angles of a quadrilateral be x,2x,3x & 4x

By angle sum property of a quadrilateral, we get

$$x + 2x + 3x + 4x = 360$$

$$10x = 360$$

$$x = 360/10 = 36$$

$$2x = 2 \times 36 = 72$$

$$3x = 3 \times 36 = 108$$

$$4x = 4 \times 36 = 144$$

Thus 4 angles of the quadrilateral are 36°, 72°, 108°, 144°.

# Worksheet 1
# Module1/4
# Understanding Quadrilaterals

Q.1. Fill in the blanks

1. A quadrilateral has ------diagonals.

2. The sum of the angles of a quadrilateral is ------.

3. The sum of the angles of a quadrilateral is ----- right angles.

4. The number of sides and the number of diagonals is same in a --.

5. The regular polygon having 4 sides is called a -----.

Q.2. The angles of a quadrilateral are in the ratio 3:5:7:9. Find the angles of the quadrilateral.

Q.3. Three angles of a quadrilateral are equal. Fourth angle is of measure 150°. What is the measure of each of the equal angles ?

Q. 4.Three angles of a quadrilateral are 110°,50° and 40° . find the measure of its fourth angle.

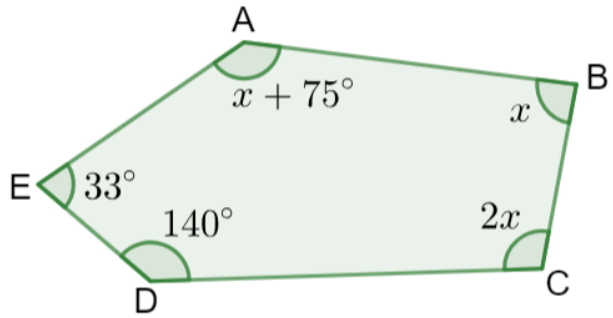
Q.5. If the sum of two angles of a quadrilateral is 180°, what is the sum of remaining two angles?

Q.6. How many sides has a regular polygon, each angle of which is of measure 108°?

Q.7. The interior angle of a regular polygon is 156°. Find the number of sides of the polygon.

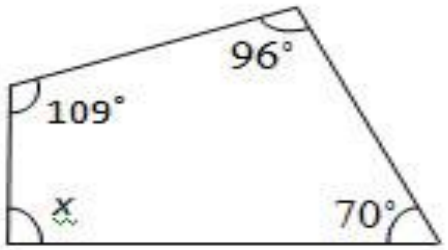
Q.8. What is the measure of each angle of a regular hexagon ?

Q.9. Find ‘x’ in the figure shown aside.

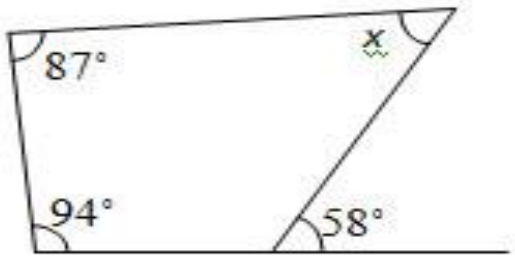


Q.10.Find ‘x’ in the following figures.

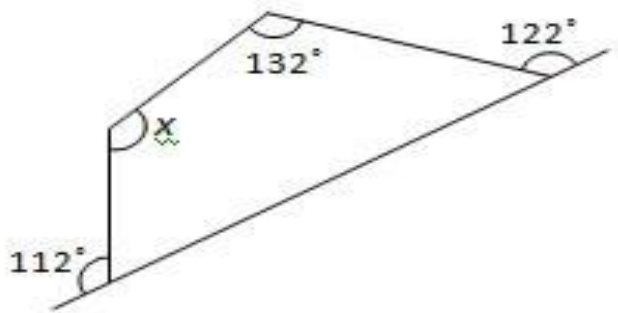
a)




b)




c)



# ch.3 Understanding Quadrilateral
## Handout 1/4

1)**Polygon**- A simple closed figure made up of only line segments is called a polygon.

2)No. of diagonals of a polygon = $n(n-3)/2$

3) **Convex and Concave polygon** – A polygon is said to be a convex polygon if the line segment joining any two points in its interior lies completely in its interior. A polygon which is not convex Is called as concave polygon.

4) **Regular and Irregular polygons** – A polygon is said to be a regular polygon if all its sides and all its angles are equal.

5)Sum of angles of a polygon = $( n-2) \times 180^{o}$ , $n \geq 4$

# Thank You

Made by- Bhavana Dale

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